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AIRCRAFT AGE IMPACTS ON MAINTENANCE REQUIREMENTS

This study develops methodology, techniques and procedures for evaluation of key cost drivers that are strongly correlated with aircraft population age. Detailed Navy fleet maintenance history records by individual aircraft from the Naval Aviation Logistics Data Analysis (NALDA) system are used to examine Mean Flight Hour Between Failure (MFHBF) and Direct Maintenance Man-hours (DMH) relationships for aircraft production blocks that entered service concurrently. This service year grouping of aircraft is then extended to all aircraft procured in a Type/Model/Series. Results of these analyses, conducted on the F/A-18A/B, F-14A, CH-53E, and E-2C show very consistent age related patterns both at the whole aircraft level and for almost all major subsystems.

Traditional reporting of Reliability and Maintainability and operating costs obscures these age relationships because data is provided on all aircraft operating within a given fiscal year. The reporting aircraft population has a mixture of aircraft of different ages. Often the more recent production aircraft, which are inherently more reliable and sometimes reflect improved reliability and maintainability as the design evolves, fly a disproportionate number of the flight hours.

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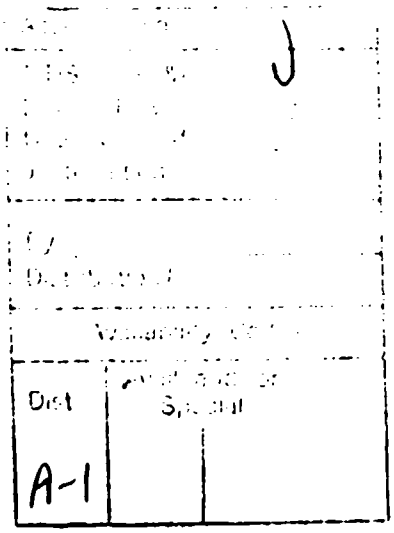

Technical Report

6

AGE IMPACTS ON OPERATING AND SUPPORT COSTS

NAVY AIRCRAFT AGE ANALYSIS METHODOLOGY

Prepared for the

27th Annual DoD Cost Analysis Symposium,
Operations and Support Costing Workshop

by

NAVAL AVIATION MAINTENANCE OFFICE
LOGISTICS ENGINEERING DEPARTMENT
RESOURCE ANALYSIS DIVISION

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INTRODUCTION

BACKGROUND

Under the current defense environment, decreasing economic resources limit new aircraft acquisition programs. As a consequence the Services will be forced to operate aging aircraft without replacement for many critical missions. The impact of this average age increase upon future Operating and Support (O&S) costs must be assessed properly if the Department of Defense decision makers are to make properly informed downsizing decisions.

The Naval Aviation Maintenance Office, Logistics Engineering Department, Resource Analysis Division, has developed methodology, techniques and procedures for evaluating potential relationships between the age of in-service aircraft and their O&S costs using existing data bases.

The incidence of verified material failures (VF) and the Direct Maintenance Manhours (DMH) expended to correct them are correlated to the aircraft's age during its in-service operational life and are potential indicators of increased O&S Costs.

The Naval Aviation Logistics Data Analysis (NALDA) data bases for Navy and Marine Corp aircraft contain historical operations and maintenance data which can serve as age indicators.

Evaluating a subject aircraft population across fiscal years is the common way that most Reliability and Maintainability data is analyzed. The problem is that in the data set for each fiscal year there is a mix of aircraft with different service ages. This partially obscures underlying trends in the effects of in-service age because the infusion of new aircraft over several years tends to offset the degradation of the older aircraft. A different approach is to group the subject aircraft according to common delivery date and evaluate the data across in-service years.

METHODOLOGY

SOURCE OF DATA:

Data elements in the current NALDA data bases, for in-service aircraft, were examined for use as indicators of the impact of aging on aircraft maintenance requirements. Verified Failures (VF), Direct Maintenance Manhours (DMH) and Total Flight Hours (FH) were selected as the age indicating data elements.

The following Naval Aviation Logistics Data Analysis (NALDA) data bases for Navy and Marine Corp aircraft contain historical operations and maintenance data:

Fleet Originated Job (FOJ) - (O and I level Maintenance Actions)

Technical Directive Status Accounting (TDSA) - (Modification)

Equipment Condition Analysis (ECA) - (Maintenance Analysis)

The current NALDA FOJ and TDSA data bases contain the data elements necessary to identify the subject aircraft within the population and the ECA data base provides the Flight Hour (FH), Verified Failure (VF) and Direct Maintenance Manhour (DMH) data for age analysis.

SCOPING the aircraft population for Age Analysis:

An aircraft population of homogeneous systems configuration and eight to ten in-service years is optimal for meaningful age analysis. The subject aircraft is first selected by Type/Model/Series (T/M/S) which is identified in the data bases by Type Equipment Code (TEC).

The NALDA TDSA data base provided the current status and configuration of the subject aircraft by Bureau Number (BUNO). The NALDA FOJ data base provided a listing of the actual TECs and BUNOs currently being reported at organizational and intermediate maintenance levels.

The Avionics Installation Plan, published by the Naval Avionics Center, provided aircraft production data. This data lists the Contract Number and date, Quantity of aircraft, inclusive bureau number range and delivery dates for each production group (Block or Lot). This aided in grouping the subject aircraft according to common delivery year for age analysis. An example is shown on Enclosure (1) page 1.

SELECTION PARAMETERS for extracting data from the NALDA ECA system:

The aircraft production groups were defined by inclusive verified Bureau Number sequence. For time frames, Fiscal years are defined by Julian dates. Major aircraft systems (such as airframe, power plant, flight controls, etc.) are defined by Work Unit Codes at the two digit level.

NALDA DATA EXTRACTION

NALDA ECA "710" Flight Activity, Inventory and Utilization reports were run to provide total Flight Hours for the aircraft production groups by fiscal year. NALDA ECA "517" Verified Failure Ranking reports were run to provide verified failure data at the two digit Work Unit Code level for the same production group and fiscal year. These reports were run for each aircraft age group (block , lot). One of these reports was extracted for each production group and fiscal year.

DATA PROCESSING / DATA REDUCTION:

As the reports were produced they were downloaded as ASCII files to Personal Computers (PCs) and imported into spreadsheet format. QUATROPRO was the software used for this processing.

When this was done for each of the aircraft production block/lot and fiscal year data sets, they were filed on linked spreadsheets with common cell addresses.

The Verified Failure (VF) and Direct Maintenance Manhour (DMH) data, extracted from the NALDA ECA "517",Ranking Program - Verified Failure, and "710", Flight Activity - Inventory and Utilization reports, for each production group were compiled in tables by two digit WUC for the time frame beginning with the first Fiscal Year (FY) after production group delivery through the latest fiscal year of available data. An example is shown on Enclosure (1) page 2.

The FY Total Flight Hours, Average Number of Reporting Aircraft, and Total WUC Verified Failure (VF) and Direct Maintenance Manhour (DMH) values were taken from the database VF and DMH spreadsheet tables for each production group. Enclosure (1) page 3 is an example of such a table.

Tables of Mean Flight Hours Between Failures (MFHBF) were derived by dividing the total flight hours by the total failures for each production group and fiscal year. Enclosure (1) page 4 is an example. Similar tables were constructed for Direct Maintenance Manhours per Flight Hour and per Verified Failure (DMH/FH, DMH/VF).

AGE ALIGNED TABLES

To permit more equitable age comparison between production groups, the fiscal years must be expressed in terms of In-service Years beginning with the year of first delivery. To do this, data points were realigned from Fiscal Year to In-service Year. Enclosure (1) page 5 is the table for the H-53E helicopter.

These values were aligned by in-service year to compile Total Flight Hour, Average Reporting Aircraft, VF, and DMH Tables such as Enclosure (1) page 6.

The first fiscal year in which all aircraft in the group were operational was considered as In-service Year One.

Even if data was not available for the early In-service years of the older aircraft, since the delivery year for each of those production groups was known, the in-service year for which data first became available could be deduced.

TABULATED DATA POINTS

From this data, tables of calculated values were constructed for Mean Flight Hours Between Failures (MFHBF), Direct Maintenance Manhours per Flight Hour (DMH/FH), and Direct Maintenance Manhours per Verified Failure (DMH/VF) as shown on Enclosure (1) page 7. The averages of MFHBF, DMH/FH, AND DMH/VF at the total aircraft level and also at the two digit WUC system level were taken for each In-service year of the corresponding production groups. From these reports further tabular and graphic reports, for the total aircraft and each two digit WUC grouping, were generated for subsequent trend analysis. The contribution of the major systems, at the two digit WUC level, to the total aircraft average MFHBF was considered by first ranking the two digit WUCs by total Verified Failures for all production groups. The highest ranking WUCs were selected for more detailed analysis. The WUC ranking for the H-53E helicopter is shown on Enclosure (1) page 8.

TREND LINES ESTABLISHED

A linear regression was performed on the Average MFHBF values to reveal any trends. An example is shown on Enclosure (1) page 9. Based on the results of the linear regression, a constant percentage decrease in predicted MFHBF, DMH/FH, and DMH/VF was calculated by expressing the slope of the predicted trend line as a percent per year.

GRAPHS PLOTTED

The data points from these tables were then plotted according to in-service year for the total aircraft and the selected two digit WUCs to make the comparison charts.

The Average MFHBF,DMH/FH, AND DMH/VF, counting all WUCs for the total aircraft, vs Aircraft Service Life (In-service years) was graphically plotted for all aircraft and for each production block/lot such as on Enclosure (1) page 10. Similar plots were drawn for each major system two-digit Work Unit Code (WUC). Enclosure (1) pages 12 and 13 are the airframe (WUC 11) and Engines (WUC 22) for the H-53E helicopter.

ANALYSIS

At the time this presentation was prepared, age analyses by service year had been performed on four different type model Navy aircraft; the F-14 fighter aircraft, the F/A-18 fighter/attack aircraft, the E-2C electronics warfare aircraft, and the H-53E helicopter. The F-14 and E-2C provided almost 20 years worth of maintenance data while the later F/A-18 and H-53E provided ten years of data. A separate detailed report was written on each of these aircraft. For this presentation the essential findings of those reports have been combined and summarized.

MEAN FLIGHT HOURS BETWEEN FAILURES (MFHBF):

The MFHBF parameter is not only a measure of operational reliability but it is also an indicator of O&S material costs. Any decrease in MFHBF over time will reflect a corresponding increase in material cost.

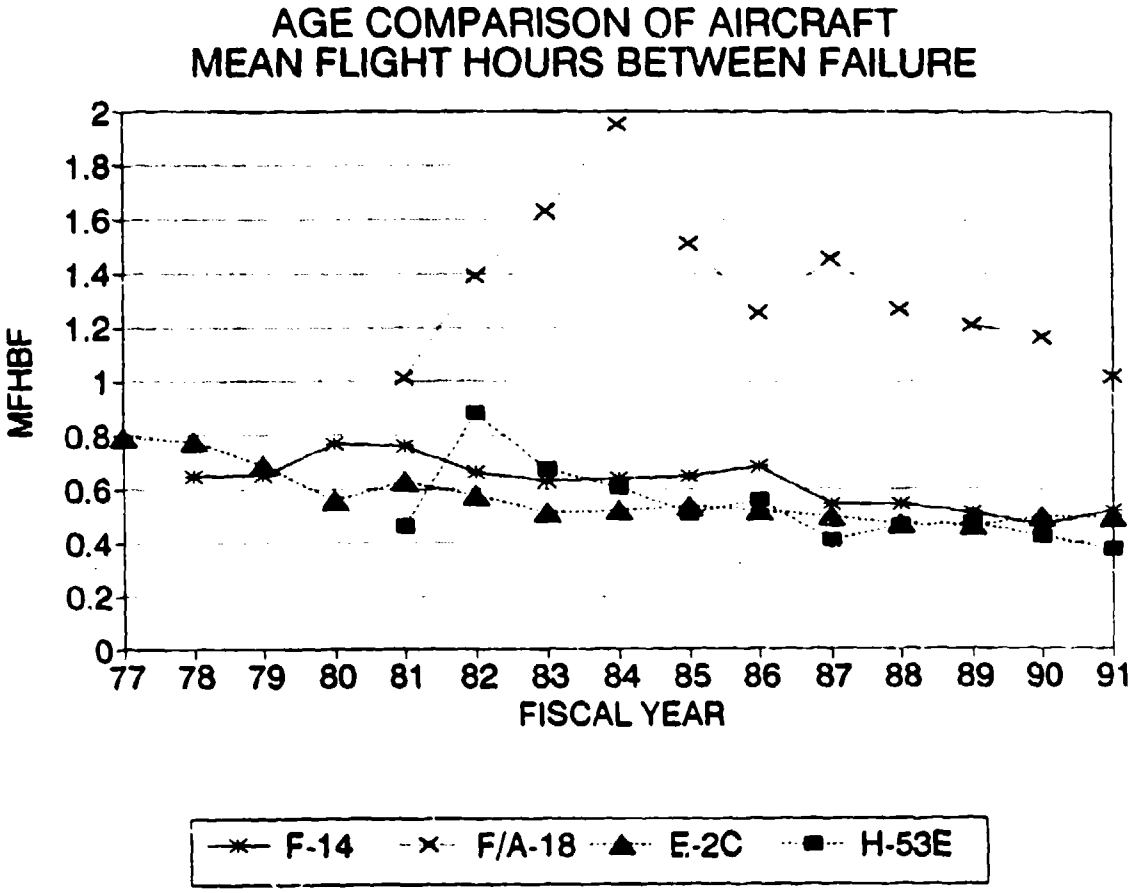


Figure 1

Figure 1 charts the MFHBF for the four subject aircraft Type Models by the traditional fiscal years. The data for this chart was based on total population and all systems. The F-14 and the E-2C have been well established in service by the time useable maintenance data first became available and their MFHBF appears to be stable. The H-53E and the F/A-18 join the others beginning in 1981. The higher reliability of the new technology in the F/A-18 is apparent. Keep in mind that there is a continuing periodic influx of new aircraft being added to the populations during the time frame shown.

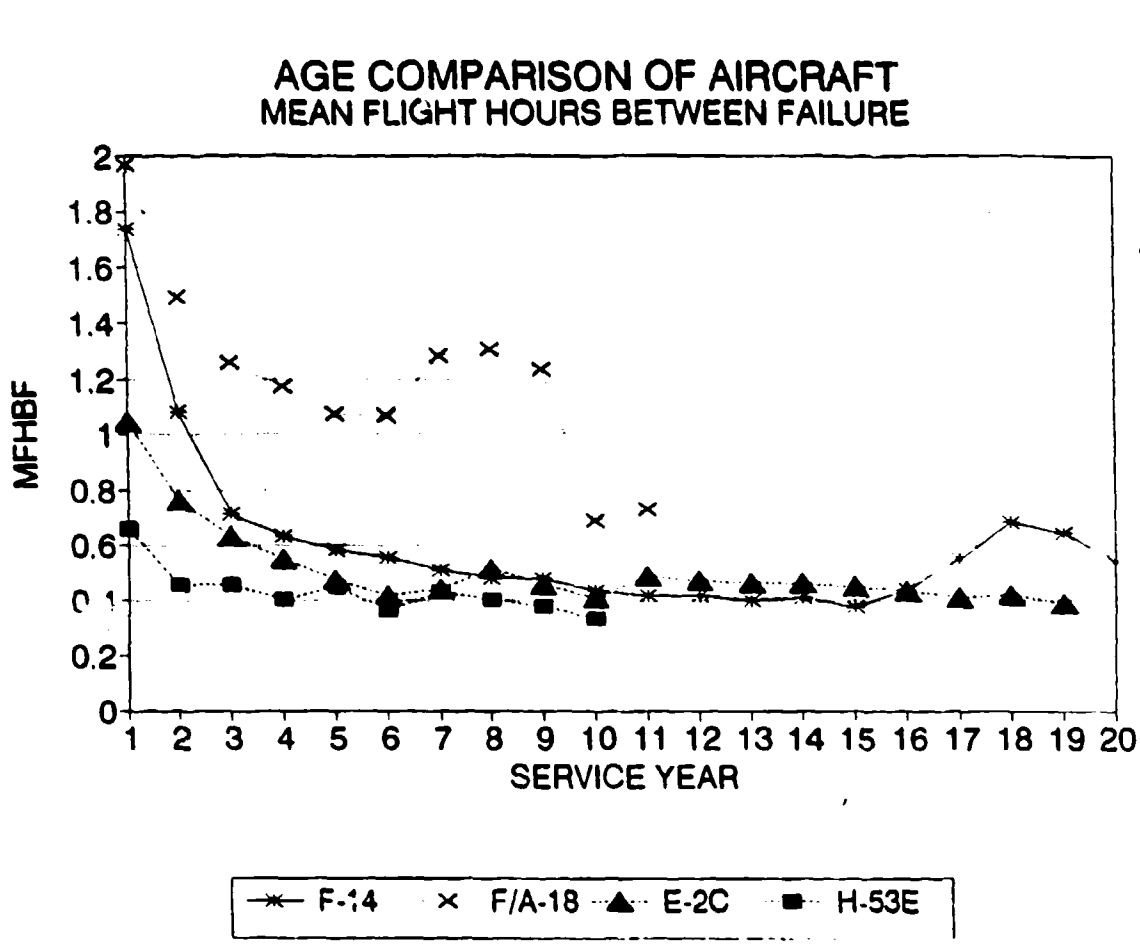


Figure 2

Figure 2 charts the same MFHBF data for the same aircraft but aligned by service year. The initial precipitous decline in reliability over the first few years becomes obvious. Then, as the aircraft age, the MFHBF appears to stabilize to a more gradual decline but at a lower level than that shown on the figure 1 fiscal year chart. On the service year chart upward excursions in MFHBF are more apt to indicate scheduled depot level maintenance instead of the influx of new aircraft. This is most noticeable after year six for the F/A-18 which is subject to the Modification, Corrosion And Paint Program (MCAPP) at that time. The F/A-18 data points in the tenth and eleventh year represent nine and one aircraft respectively having reached that age, less than two percent of the population, and which were not subject to MCAPP. The MFHBF increase in the later years of the F-14 appear to be primarily due to the incorporation of major depot level modifications in two of the oldest production blocks. Under service year analysis the patterns of MFHBF of all four Type Model aircraft are very similar and consistent. To be more useful to cost analysts in predicting future O&S costs the change in MFHBF over time needs to be expressed in a more generic form. To accomplish this linear regressions were performed on the preceding charts to reveal any common trends.

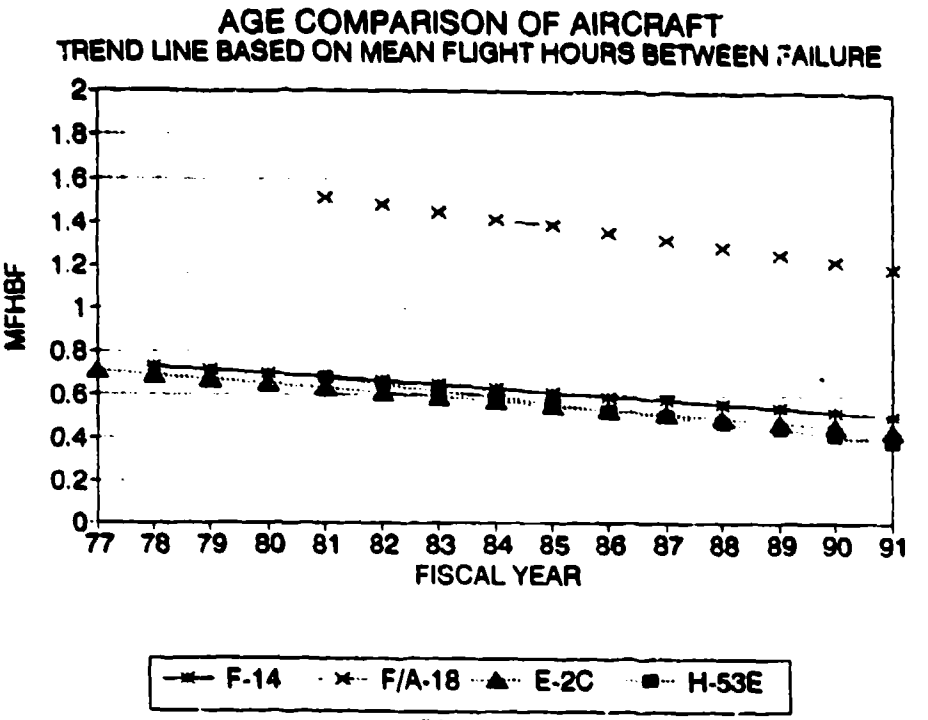


Figure 3

Figure 3 presents the linearly regressed trends of the MFHBF fiscal year chart figure 1. Only a slight decrease in MFHBF over time is apparent. The newer-technology of the F/A-18 appears to give it a higher MFHBF with only a slightly steeper decrease over time. When the regression is applied to the service year MFHBF chart a different picture emerges.

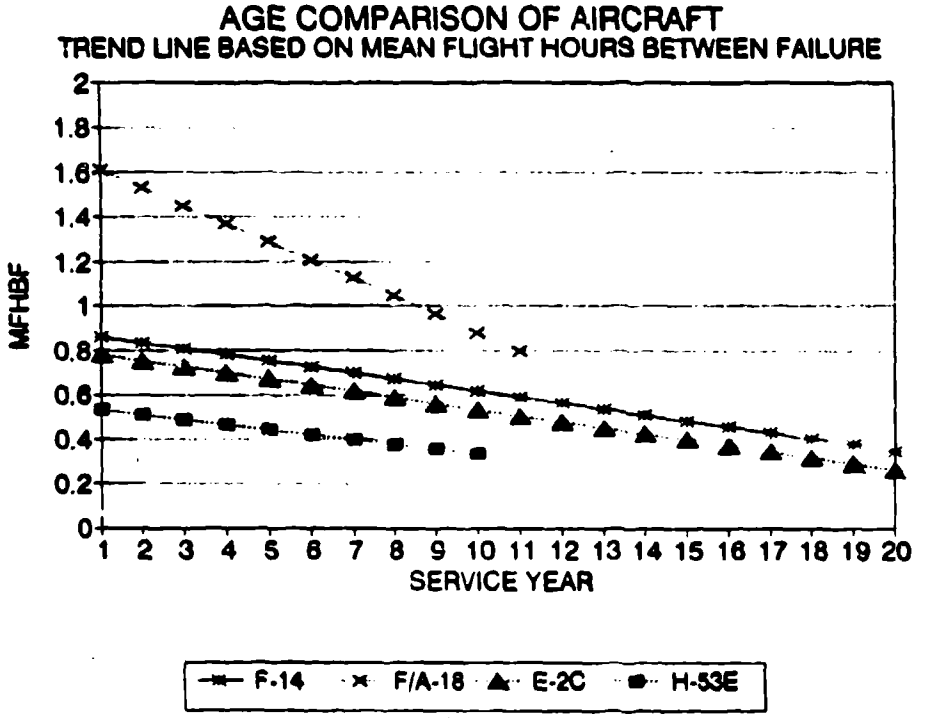


Figure 4

Figure 4 shows the MFHBF trends based on service years. Significantly steeper rates of decrease in MFHBF are apparent. Although the F/A-18 starts out with a much higher value of MFHBF it degrades much more rapidly.

DIRECT MAINTENANCE MANHOURS PER FLIGHT HOUR (DMH/FH):

The DMH/FH parameter is an indicator of O&S labor cost. Although affected to some degree by maintenance management policy and training, DMH/FH it is primarily driven by the material condition of the aircraft which is a major O&S cost driver. The F-14 aircraft was the first subject for age analysis and initially only verified failure data was extracted from NALDA providing only the MFHBF data points. With the F/A-18, H-53E, and E-2C aircraft, direct maintenance manhour data was also extracted providing the additional DMH/FH data points. Any increase in DMH/FH over time will reflect a corresponding increase in labor cost.

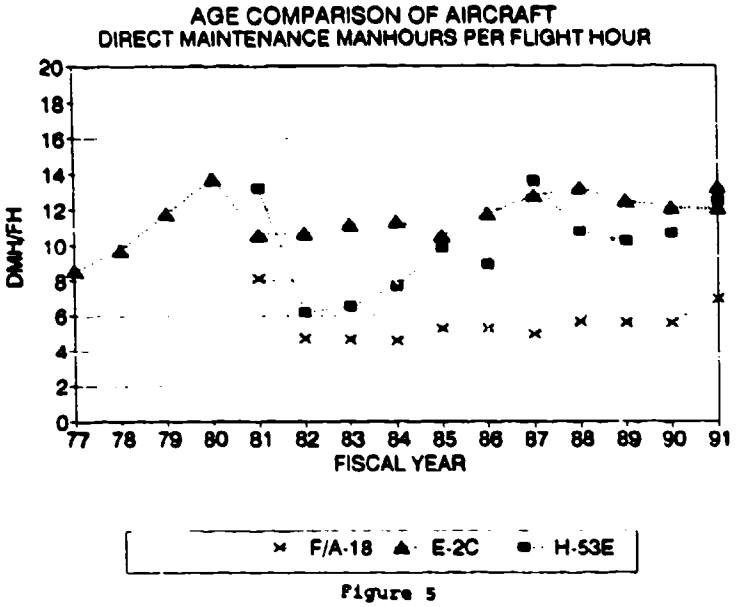


Figure 5

Figure 5 depicts the DMH/FH expended by fiscal years for three of the subject aircraft. When viewed by fiscal year the effects of aging of individual aircraft on maintenance manhours are averaged out. Training and maintenance policy have a more noticeable effect. This is evident by the initial high values for the F/A-18 and H-53E in 1981 when the new models were first introduced to operating units. Only a gradual increase over time can be discerned. For the F/A-18, the values are nearly constant.

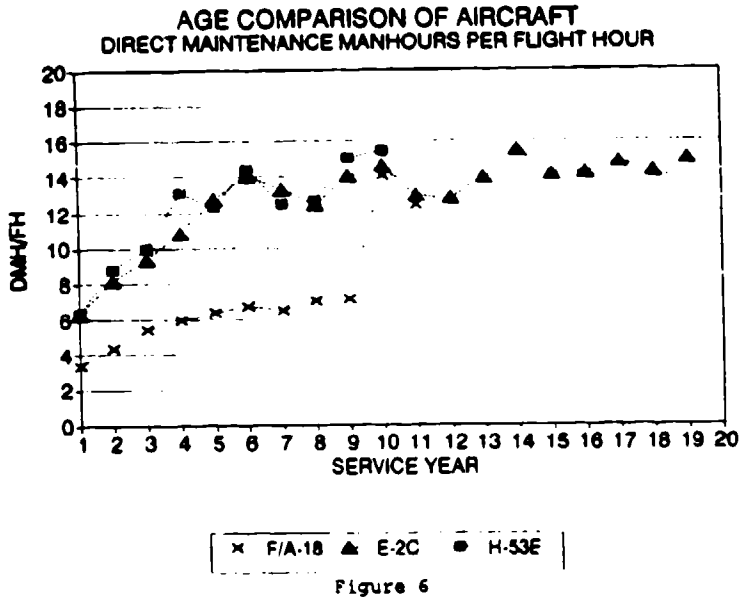


Figure 6

Figure 6 displays the DMH/FH aligned by service year. The effect of age is more apparent. The rate of increase in manhours expended during the early years is significantly higher. Again, as with MFHBF, the F/A-18 data points for service years ten and eleven are the result of the first nine and one aircraft respectively representing less than two percent of the population.

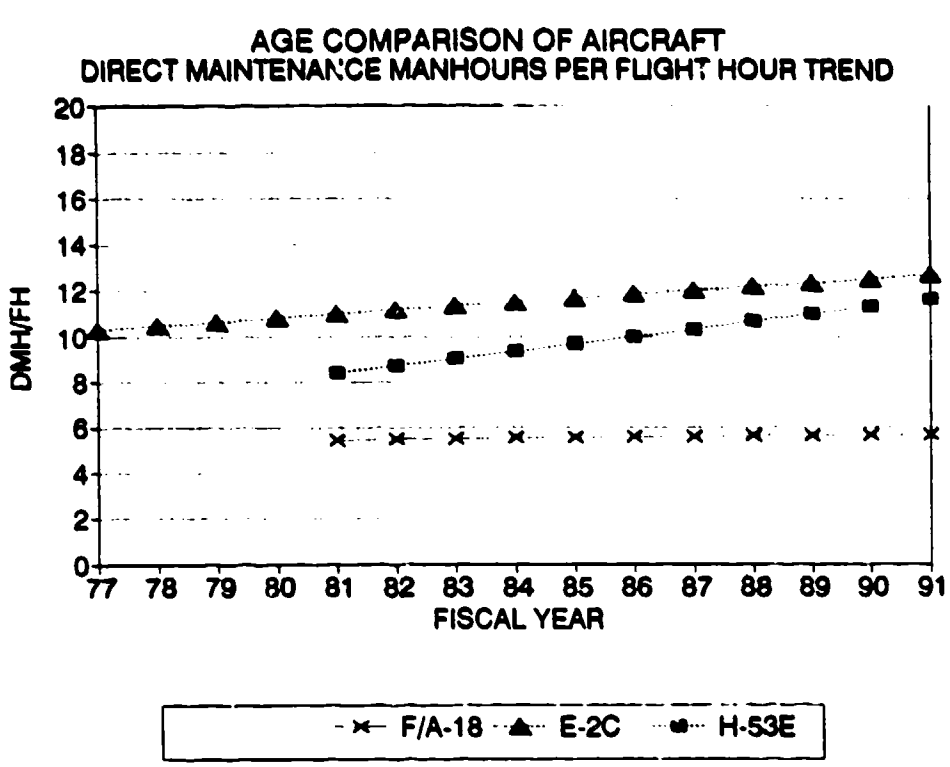


Figure 7

Figure 7 shows the linearly regressed trends of the DMH/FH chart by fiscal year. It confirms the minimal increase in DMH/FH over time for the E-2C and H-53E and the nearly constant rate for the F/A-18.

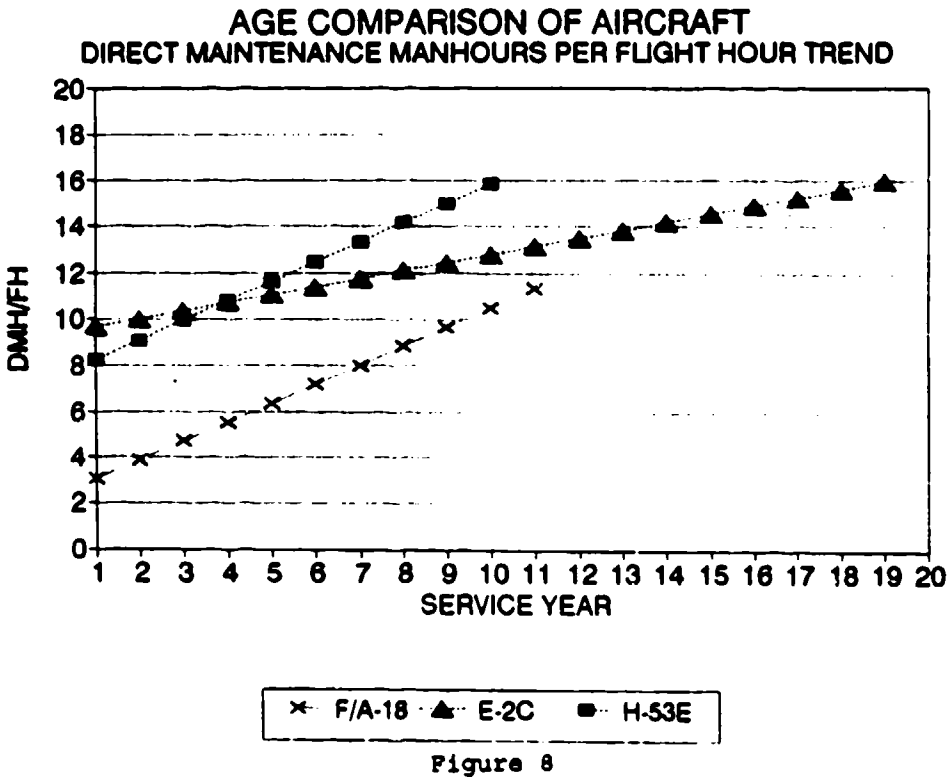


Figure 8

Figure 8 displays the DMH/FH trends when aligned by service year. A truer picture of the effect of aircraft age is revealed. For the E-2C the increase is only slightly higher. It is significantly higher for the H-53E and the F/A-18.

From the trend data the percent change per year of MFHBF and DMH/FH were calculated and tabulated for each of the subject Type Model aircraft. The comparison between fiscal year and service year aircraft age analysis, in terms of percent change per year, is presented below in table 1.

AGE COMPARISON OF AIRCRAFT PERCENT CHANGE PER YEAR				
AIRCRAFT TYPE/MODEL	MFHBF		DMH/FH	
	FISCAL YEAR %	SERVICE YEAR %	FISCAL YEAR %	SERVICE YEAR %
F-14	-2.6	-3.2		
F/A-18	-2.2	-5.0	0.4	27.2
H-53E	-4.4	-4.0	3.8	11.4
E-2C	-3.2	-3.9	1.6	3.3

Table 1.

DIRECT MAINTENANCE MANHOURS PER VERIFIED FAILURE (DMH/VF):

DMH/VF was also considered as an aircraft age parameter. After detailed evaluation it was evident that DMH/VF optimally should tend to a constant value. It is primarily driven by maintenance policy and training factors. Aging factors have a minimal effect on DMH/VF.

CONTRIBUTION OF MAJOR SYSTEMS - TWO DIGIT WORK UNIT CODE (WUC):

Age analysis by service year was also applied to the major systems of each of the subject aircraft. The results were consistent and parallel to that of the aircraft as a whole. With few exceptions, all major systems show the varying degrees of decrease in Average MFHBF over time and corresponding increase in DMH/FH and DMH/VF just as with the total aircraft level.

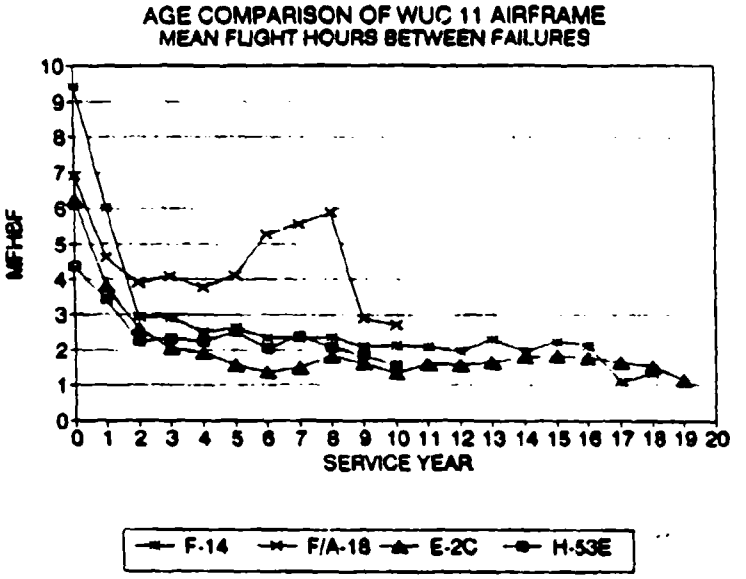


Figure 9

Figure 9 presents MFHBF values for the four subject aircraft for the airframe system, WUC 11. It corresponds closely to the MFHBF aircraft as a whole in figure 2.

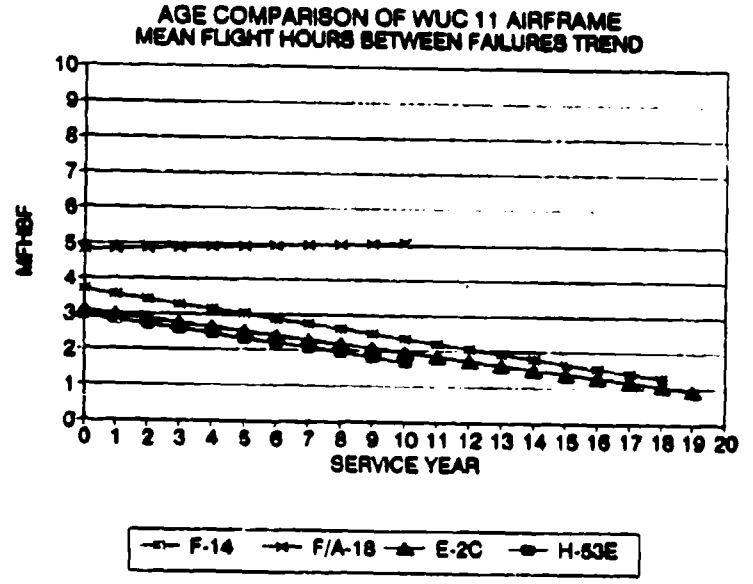


Figure 10

Figure 10 shows the trends of figure 9. Again, it is similar to its whole aircraft counter part in figure 4. An interesting feature here is that, for the F/A-18, the trend for airframe MFHBF is nearly constant which may reflect favorably on the incorporation of composite technology in aircraft structure.

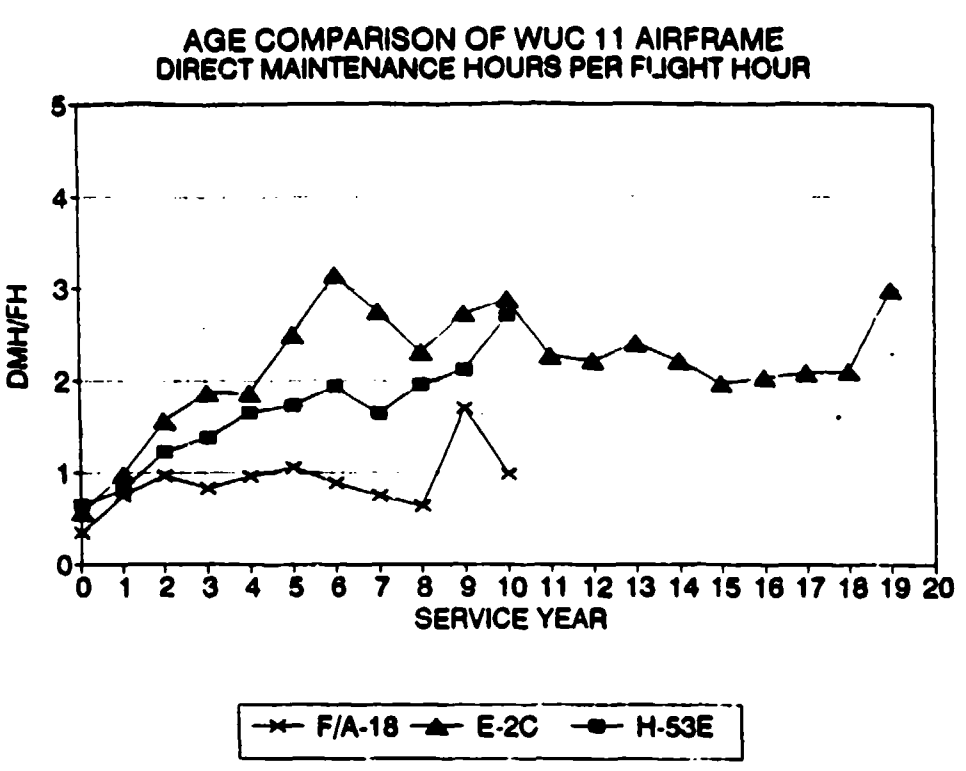


Figure 11

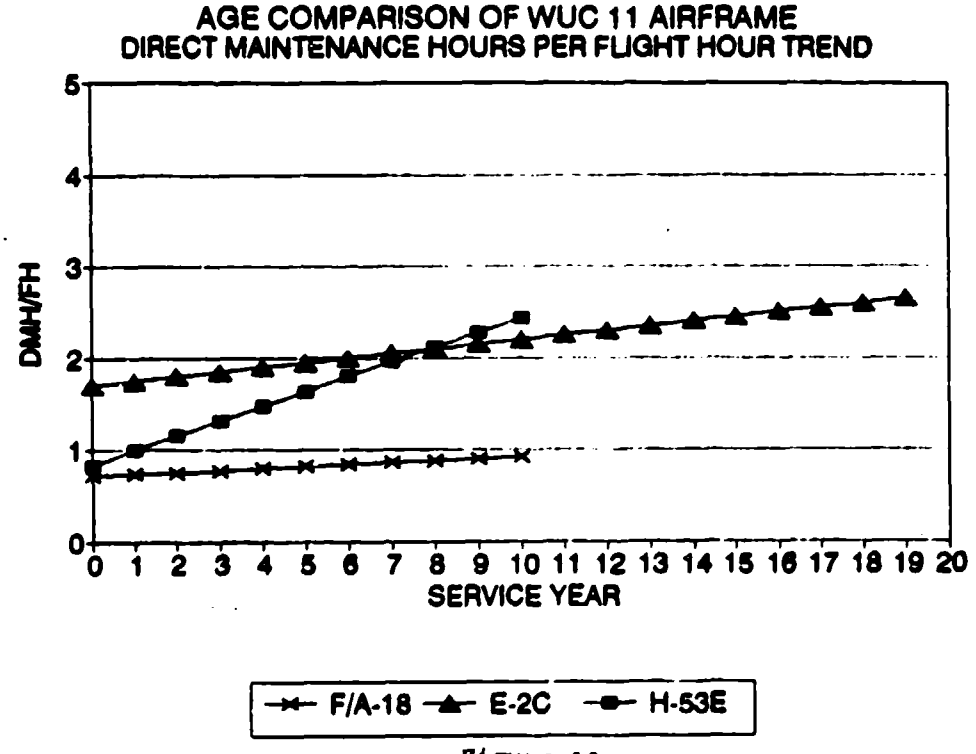


Figure 12

Figures 11 and 12 are the charts of DMH/FH for the airframe system, WUC 11, also similar to their whole aircraft counterparts, figures 6 and 8 respectively. Other examples are found on enclosure (1) pages 12 through 18.

From the trend data the percent change per year of MFHBF and DMH/FH were calculated and tabulated for each major aircraft system two digit WUC. An example for the F/A-18 is shown in table 2.

F/A-18A/B SIGNIFICANT MAJOR SYSTEMS CONTRIBUTING TO MAINTENANCE WORKLOAD
BASED ON TOTAL REPORTED WUC FAILURE AND MANHOUR DATA

F18 WORK UNIT CODES MAJOR SYSTEMS WUC		FAILURES	MANHOUR	MFHBF % CHANGE PER YEAR	DMH/FH % CHANGE PER YEAR	DMH/VF % CHANGE PER YEAR	WUC
11	AIRFRAME	186963	686720.0	0.511	2.892	5.729	11
13	LDG GEAR	58939	400218.6	-4.888	8.532	1.282	13
14	FLT CNTL	47202	504486.3	-6.240	12.097	1.980	14
24	AUX PP (AIRBORNE)	5262	61688.8	-3.798	2.870	-1.006	24
27	F404 ENGINES	20928	179373.9	-6.991	0.595	-4.844	27
29	PP INSTLN	13877	104286.1	-7.042	15.889	3.719	29
41	A/COND,PRES,ANTI-ICE	19654	130563.4	-7.362	25.151	5.706	41
42	ELECTR PWR SUPPLY	16199	169464.8	-5.915	17.727	3.861	42
44	LIGHTING SYS	19902	102972.6	-5.178	5.491	-0.766	44
45	HYD/PNEUM PWR	6814	74673.7	-10.083	51.779	2.293	45
46	FUEL SYS	21040	236316.9	-4.131	13.056	3.470	46
51	INSTR SYS	6434	48464.6	-5.551	27.096	7.623	51
57	INTGR GUIDE/FLT CNTL	9068	123804.9	-7.290	26.612	6.909	57
58	IN-FLIGHT TEST EQ	6789	71307.5	-5.150	22.116	9.513	58
62	VHF COMM	7228	52902.6	-8.381	57.383	10.237	62
67	COM/NAV/IFF INTEGR	9660	81220.8	-2.029	12.566	14.210	67
73	BOMB NAV SYS	15096	228966.2	-1.674	8.122	5.610	73
74	WEAPNS CNTL SYS	67481	612334.8	-3.669	11.978	5.586	74
75	WEAPON DELV	39741	106186.6	1.921	-0.454	1.307	75
76	COUNTERMEASURES	12025	102824.2	-0.494	12.016	5.712	76

(- INDICATES DECREASING TREND)

Table 2

Not all of the major systems or components contribute directly to the aging of the aircraft platform. Those that are mission or weapon specific may experience independent aging characteristics not directly related to flight time. Also, modifications to correct existing problems can decrease the incidence of failure while those which introduce new technology subsystems can often increase it.

CONCLUSION

Age analysis by service year revealed a definite decrease in the Average MFHBF and a corresponding increase in DMH/FH and DMH/VF for each of the aircraft analyzed to date. This reflects a corresponding increase in O&S costs over the life cycle of the aircraft due to more frequent maintenance actions and consumption of repair material as each aircraft gets older. Verified Failure and Direct Maintenance Manhour data normalized by total Flight Hours and averaged for the aircraft in each production block for each in-service year appears to provide a consistent indication of the aging of these aircraft and their major systems. For Navy aircraft, the data set necessary for such analysis is available in the NALDA ECA data system. DMH as well as MFHBF can serve as significant aircraft aging indicators. The data can be aligned according to in-service age for each production block. The results display a consistent decrease in the Average MFHBF over time for these aircraft. At the two digit WUC level, all major systems show the varying degrees of decrease in Average MFHBF over time just as with the total aircraft level. A pattern that emerges here is that those major systems with initially high Average MFHBF also tend to experience high rates of decrease in those values over time.

In the present economic environment the Defense Services will have to operate aging aircraft without the frequent infusion of new aircraft, as in the past, to temper the real increases in O&S costs. In estimating projected O&S costs for aging aircraft, the percentage increases will be more like those exhibited by the service year cost driver analyses rather than the fiscal year analyses. Age analysis by service year of populations of aircraft, which were procured incrementally over a span of years, reveals truer trends of the O&S cost drivers. The percentage changes derived by age analysis can be applied in more accurately forecasting projected O&S costs for one-time acquisition of new aircraft as well as the continued operation of existing aircraft.

H-53E HELICOPTER PRODUCTION BLOCKS

BLOCK	1ST YR	BUNO RANGE	AHXD	TEC AHXJ
0	75	159877	1 CH	
01	82	161179 - 161184	6 CH	
02	82	161252 - 161265	14 CH	
03	83	161381 - 161395	14 CH	1 MH
04	84	161532 - 161543	12 CH	
05	84	161988 - 162001	14 CH	
06	85	162002 - 162012	11 CH	
07	86	162478 - 162488	11 CH	
08	86	162489 - 162496	8 CH	
09	87	162497 - 162502	4 CH	2 MH
10	88	162503 - 162512		10 MH
11	89	162513 - 162516		4 MH
12	89	162517 - 162526	10 CH	
13	90	163051 - 163058		8 MH
14	90	163059 - 163064	6 CH	
15	91	163065 - 163071		7 MH
16	91	163072 - 163078	7 CH	
17	92	163079 - 163087	9 CH	
	?	163089	1 CH	

T/M: H-53E MAINTENANCE DATA BUNO RI 161391 161395 PRODUCTION BLOCK 03

VERIFIED FAILURES

	FY	82	83	84	85	86	87	88	89	90	91	TOTAL
	SVC YR	0	1	2	3	4	5	6	7	8	9	1 - 10
WUC												
11	AIRFRAME	194	1268	1389	946	686	476	818	864	1086	1121	8743
12	FUSLG COMPT	46	246	191	289	391	184	246	240	243	333	2137
13	LDGEAR	61	286	286	186	239	146	283	361	284	286	2360
14	FLT CONTR	36	177	284	257	248	170	280	289	233	264	2148
15	ROTOR	180	888	1077	948	737	681	760	1031	923	926	7834
22	ENGINES	46	147	92	136	187	108	227	126	129	111	1330
24	AUX PWR	47	232	187	178	188	88	139	181	187	137	1502
26	DRIVES/COMBN	88	478	488	438	304	284	371	532	428	409	3787
29	ENG INSTAL	180	891	913	948	891	446	760	906	1000	966	7901
41	AC/PRES	26	43	6	7	13	6	11	10	10	11	143
42	ELECT PWR	36	230	186	289	344	209	307	346	416	446	2786
44	LIGHTING	80	309	396	216	844	136	246	370	284	223	2444
46	HYD/PNEU	16	103	116	97	109	87	130	186	108	116	1032
48	FUEL SYS	66	306	314	276	244	191	336	289	236	286	2536
49	MSC UTIL	11	84	113	76	80	46	84	76	83	90	744
51	INSTR	17	86	86	116	83	46	89	84	80	76	676
56	FLT REP	6	26	22	12	17	13	24	36	20	36	206
57	INTGR GUID	16	77	80	106	86	61	86	116	106	123	666
61	HF	2	26	36	36	16	8	23	27	26	16	213
62	VHF	1	26	20	27	24	26	36	46	37	42	286
63	UHF	16	26	33	26	27	16	37	34	37	24	271
64	INTERCOM	27	41	36	44	106	41	66	66	66	66	612
65	IFF	1	16	6	6	4	6	11	6	6	16	78
66	ELT	0	0	0	0	0	1	6	4	10	8	29
67	COM/NAV/IFF	0	1	1	2	11	6	16	6	6	7	54
69	MSC COMM	0	0	1	0	0	0	0	2	1	0	4
71	RADIO NAV	0	34	26	36	46	36	66	63	66	61	426
72	RADAR NAV	6	16	14	16	36	27	16	24	16	27	202
73	BOMBING NAV	0	0	0	0	0	0	0	0	0	1	1
76	WEAPN DEL	0	1	1	0	0	4	4	3	3	4	20
78	COUNTERMEAS	0	2	12	8	6	12	27	16	21	20	127
77	PHOTORECON	0	0	0	0	0	0	0	0	0	0	0
91	EMERG EQUIP	27	46	26	27	16	6	6	6	6	6	176
92	TOW TARGET	0	0	0	0	0	0	0	1	0	0	1
96	PERS EQUIP	0	0	1	1	0	2	2	2	0	2	10
97	EXPL DEV	0	0	0	3	4	0	0	0	6	10	46
	TOTAL	1172	6013	6806	6821	6182	3410	6836	6483	6109	6163	51754
	TOTAL FLT HRS	536.3	4006.3	3636.3	3460.6	2677.2	1366.6	2460.2	4301.2	3378.3	2702.1	
	AVG No. AC/FT	6.3	13.6	12.6	10.6	8.7	6.9	8.3	13.6	13.1	11.6	

T/M: H-53E MAINTENANCE DATA BUNO RI 161391 161395 PRODUCTION BLOCK 03

DIRECT MAINTENANCE MANHOURS

	FY	82	83	84	85	86	87	88	89	90	91	TOTAL
	SVC	0	1	2	3	4	5	6	7	8	9	1 - 10
WUC												
11	AIRFRAME	1080.4	4751.1	5228.2	4448.8	3408.3	1978.8	2894.3	3660.0	3908.5	4668.8	36607.6
12	FUSLG COMPT	188.3	606.9	616.6	708.6	733.6	467.6	666.9	788.8	612.5	1133.9	6468.5
13	LDGEAR	346.9	1308.3	1284.9	782.0	1068.6	616.6	1036.4	1488.8	1016.5	1446.7	10304.8
14	FLT CONTR	274.6	1230.2	1746.7	2285.2	1813.1	1368.0	1668.4	2010.0	1646.4	2186.4	16028.0
15	ROTOR	1222.6	4386.6	6088.0	7436.9	4712.8	4382.9	5382.6	7676.7	6660.1	7918.7	56804.4
22	ENGINES	88.3	644.8	366.8	666.1	697.2	666.8	847.3	861.4	640.1	877.1	6147.2
24	AUX PWR	383.1	1287.4	861.1	1106.3	818.7	384.7	686.2	808.8	866.1	813.8	7187.3
26	DRIVES/COMBN	416.8	2073.8	2106.8	2791.3	1618.2	1887.5	1804.3	3638.8	2191.8	2881.8	20888.2
29	ENG INSTAL	663.8	3316.4	4184.4	4643.8	3736.7	1866.8	3176.8	4477.2	4686.1	6364.7	37192.8
41	AC/PRES	28.8	91.5	46.2	74.1	66.8	27.1	63.3	71.7	71.0	38.8	618.8
42	ELECT PWR	278.4	1248.3	1132.8	1288.8	1868.6	886.1	1216.8	1408.6	1788.8	1878.7	12730.8
44	LIGHTING	388.8	1366.2	1677.5	767.8	668.8	406.8	636.1	864.7	716.8	866.2	8194.8
46	HYD/PNEU	66.8	866.1	864.8	668.4	866.8	311.2	866.2	826.4	417.7	806.7	5308.3
48	FUEL SYS	408.4	1480.8	1464.1	1861.8	1068.8	866.3	1128.7	1367.3	936.8	1868.4	11861.7
49	MSC UTIL	46.8	463.8	648.1	364.8	366.3	186.3	186.8	306.4	347.8	366.2	3067.3
51	INSTR	78.2	216.3	364.8	447.7	236.4	186.3	206.2	776.3	446.2	1141.8	4064.8
56	FLT REP	34.8	167.8	136.2	131.8	131.7	86.3	106.1	316.2	86.8	416.8	1606.1
57	INTGR GUID	116.7	666.2	647.8	726.8	667.8	267.1	616.8	686.4	1263.8	1066.4	6736.8
61	HF	7.6	266.4	196.2	146.1	63.3	33.8	86.4	106.2	346.4	134.8	1286.1
62	VHF	7.8	276.7	196.2	361.1	104.8	134.1	364.3	366.1	364.8	666.1	2727.2
63	UHF	36.3	76.4	176.6	86.8	167.2	73.4	166.8	216.1	186.8	136.4	1226.8
64	INTERCOM	136.1	216.6	191.4	216.4	766.1	236.8	606.6	406.4	466.4	676.8	4081.8
65	IFF	6.8	116.7	76.2	66.1	17.2	36.3	36.6	53.1	106.5	266.8	946.6
66	ELT	0.0	0.0	0.0	0.0	0.0	3.0	8.6	27.1	136.3	266.7	421.6
67	COM/NAV/IFF	0.0	2.6	3.8	16.8	43.8	8.8	22.4	7.1	7.3	36.8	141.2
69	MSC COMM	0.0	0.0	13.0	0.0	0.0	0.0	0.0	3.0	2.0	0.0	18.0
71	RADIO NAV	84.6	216.6	166.8	137.8	266.4	231.1	266.1	304.8	606.2	1046.8	3367.7
72	RADAR NAV	112.7	166.6	101.2	141.7	766.6	184.8	114.0	166.0	184.6	436.1	1866.8
73	BOMBING NAV	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	7.0
76	WEAPN DEL	0.0	6.6	0.6	0.6	0.6	3.6	8.6	4.1	11.7	13.6	48.8
78	COUNTERMEAS	0.0	1.6	66.6	44.6	13.4	61.6	33.3	66.1	27.8	63.7	346.6
77	PHOTORECON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
91	EMERG EQUIP	36.6	63.6	27.2	46.8	31.8	12.4	8.8	6.4	4.1	8.8	230.3
92	TOW TARGET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	2.0
96	PERS EQUIP	0.0	0.0	16.0	1.0	0.0	1.1	1.8	8.0	0.0	3.4	30.3
97	EXPL DEV	0.0	0.0	0.0	4.3	8.0	10.0	12.1	22.9	3.7	20.4	78.4
	TOTAL	6304.3	27138.9	30368.8	32281.6	26816.8	17881.3	24401.4	33864.7	30188.4	36678.8	286886.4

H-53E FLIGHT DATA SUMMARY FROM NALDA ECA 710 REPORTS

PROD BLOCK	SVC YR	FY	AVG NO. AIRCRAFT REPORTING	FLIGHT HOURS	NUMBER SORTIES	HOURS EQUIPMENT IN SERVICE
01	0	81	2.1	99.5	65	6247
	1	82	3.9	958.5	523	33952
	2	83	3.9	1390.7	717	34158
	3	84	3.6	1011.5	489	31494
	4	85	3.0	920.5	526	26531
	5	86	4.2	960.4	506	36764
	6	87	1.9	340.2	195	13988
	7	88	2.3	734.9	374	19885
	8	89	3.8	1377.4	657	33425
	9	90	3.7	881.1	423	32794
	10	91	4.5	820.6	482	39484
02	0	81	1.3	62.7	29	2006
	1	82	10.2	2765.3	1352	88393
	2	83	12.8	4316.5	2091	111245
	3	84	9.6	3164.2	1540	83457
	4	85	9.2	2893.6	1421	79773
	5	86	9.5	2887.3	1452	82922
	6	87	5.3	1457.1	707	46043
	7	88	6.7	2378.5	1093	58001
	8	89	8.5	2708.0	1207	74227
	9	90	9.1	2178.7	1027	79008
	10	91	9.1	2192.6	1148	79238
03	0	82	6.3	839.3	381	27541
	1	83	13.5	4008.3	1750	116802
	2	84	12.6	3539.3	1602	109021
	3	85	10.6	2480.5	1186	91740
	4	86	9.7	2577.2	1202	84000
	5	87	5.9	1386.6	694	51035
	6	88	9.3	2460.2	1156	80357
	7	89	13.5	4301.2	1936	116910
	8	90	13.1	3378.3	1612	113285
	9	91	11.8	2702.1	1287	102671
04	0	83	4.3	990.5	403	18841
	1	84	11.5	5450.9	2793	99666
	2	85	11.1	5441.4	2800	95940
	3	86	10.6	4561.5	2749	92352
	4	87	8.2	3341.6	2512	71195
	5	88	8.1	4487.3	3303	70183
	6	89	9.8	4136.2	3186	85170
	7	90	10.5	4511.4	3372	91532
	8	91	8.5	3677.0	2977	73617
05	1	84	7.0	2088.4	986	55853
	2	85	9.3	3042.5	1496	80982
	3	86	8.8	2412.6	1187	76690
	4	87	4.9	1453.2	757	42972
	5	88	7.0	2246.7	1065	60711
	6	89	8.4	1966.8	1029	72631
	7	90	9.1	2232.6	1242	79017
	8	91	9.1	2696.6	1780	79015
06	0	84	3.4	702.8	304	14949
	1	85	8.8	3114.0	1475	76805
	2	86	9.1	2910.8	1392	78794
	3	87	6.0	1748.5	838	52052
	4	88	4.8	1415.7	714	42269
	5	89	6.2	1737.7	847	53812
	6	90	8.0	1934.4	861	69849
	7	91	7.6	1961.2	879	65733
07	0	85	6.3	1283.7	575	36612
	1	86	10.4	3444.0	1464	90515
	2	87	7.0	2168.3	946	60964
	3	88	8.7	3236.7	1454	75233
	4	89	8.6	3190.8	1387	74720
	5	90	10.2	3055.8	1325	88607
	6	91	8.4	2019.8	1082	73055
08	0	85	0.9	63.3	28	1989
	1	86	5.7	2661.2	1194	49879
	2	87	5.8	1748.6	792	50764
	3	88	7.4	2836.3	1257	64516
	4	89	6.1	2359.2	1001	53287
	5	90	8.0	2492.5	1115	69814
	6	91	7.1	1881.5	965	61934
09	0	86	0.7	82.5	37	1539
	1	87	1.3	542.4	259	10777
	2	88	3.0	1167.0	497	26157
	3	89	3.2	1524.8	611	27985
	4	90	2.9	970.7	440	25772
	5	91	4.2	1223.6	597	36577
10	0	87	2.8	853.3	330	12228
	1	88	7.9	3268.5	1348	68688
	2	89	7.3	2624.6	1192	63901
	3	90	8.5	4063.8	1790	74256
	4	91	7.2	2959.8	1420	62364
11	0	88	2.8	934.1	460	20188
	1	89	3.7	1523.1	679	32536
	2	90	3.0	1074.5	474	26624
	3	91	2.1	516.0	263	18565
12	0	88	0.1	105.4	54	592
	1	89	6.2	2542.4	1027	71446
	2	90	10.0	2370.3	1072	86973
	3	91	9.2	3049.0	1519	79828
13	0	89	2.0	851.2	351	16614
	1	90	7.4	2908.8	1183	64252
	2	91	7.9	3517.1	1383	68260
14	0	89	1.8	557.4	243	10722
	1	90	5.1	1483.1	666	44181
	2	91	4.4	1453.4	720	38579
15	0	90	1.9	411.5	153	11182
	1	91	6.2	2267.3	916	54357
16	0	90	1.8	700.7	275	11746
	1	91	6.6	2219.8	932	57545
17	0	91	1.3	448.8	181	6786

T/M H-53E MAINTENANCE DATA — MEAN FLT HRS BETWEEN FAILURES

BY FISCAL YEAR

PRODUCTION	81	82	83	84	85	86	87	88	89	90	91
BLOCK 01	0.383	0.888	0.692	0.460	0.382	0.352	0.209	0.332	0.412	0.352	0.318
BLOCK 02	0.674	0.942	0.829	0.534	0.486	0.452	0.258	0.361	0.433	0.336	0.344
BLOCK 03		0.716	0.687	0.570	0.441	0.500	0.406	0.445	0.670	0.553	0.439
BLOCK 04			0.947	0.589	0.393	0.383	0.331	0.348	0.288	0.329	0.290
BLOCK 05				0.885	0.626	0.515	0.362	0.453	0.333	0.433	0.456
BLOCK 06				1.240	0.792	0.683	0.517	0.551	0.629	0.615	0.545
BLOCK 07					0.804	0.981	0.601	0.732	0.775	0.718	0.541
BLOCK 08					1.151	1.307	0.565	0.729	0.634	0.574	0.649
BLOCK 09						2.292	0.721	0.700	0.488	0.322	0.304
BLOCK 10							0.569	0.425	0.297	0.292	0.209
BLOCK 11								0.500	0.436	0.239	0.180
BLOCK 12								2.635	1.116	0.655	0.578
BLOCK 13									0.571	0.349	0.236
BLOCK 14									1.877	0.868	0.563
BLOCK 15										0.459	0.384
BLOCK 16										3.100	1.292
BLOCK 17											2.859
AVG MFHBF	0.459	0.880	0.672	0.602	0.503	0.555	0.405	0.465	0.472	0.423	0.368

T/M H-53E MAINTENANCE DATA — DIRECT MAINT MANHOURS / FLT HOUR

BY FISCAL YEAR

PRODUCTION	81	82	83	84	85	86	87	88	89	90	91
BLOCK 01	14.534	5.833	6.643	10.424	14.418	15.083	23.160	15.974	11.130	14.763	14.880
BLOCK 02	11.061	5.931	6.794	8.331	11.177	10.977	19.461	15.036	11.414	15.661	15.696
BLOCK 03		7.511	6.771	8.569	13.014	9.784	12.896	9.918	7.894	8.937	14.646
BLOCK 04			4.149	7.330	11.117	13.343	22.145	19.249	18.596	15.592	17.531
BLOCK 05				6.018	7.844	9.934	14.438	11.531	15.317	12.580	12.792
BLOCK 06				3.709	6.528	6.701	10.873	9.503	7.408	9.095	10.902
BLOCK 07					5.042	4.504	6.990	5.610	6.204	7.985	12.856
BLOCK 08					2.872	3.565	7.773	5.556	8.217	9.303	11.737
BLOCK 09						2.104	4.543	5.471	9.238	15.426	13.684
BLOCK 10							6.593	8.371	14.378	12.241	18.828
BLOCK 11								6.177	8.909	10.834	20.997
BLOCK 12								1.020	3.643	6.939	7.637
BLOCK 13									6.042	8.221	11.547
BLOCK 14									2.065	5.219	7.267
BLOCK 15										7.061	8.319
BLOCK 16										1.652	5.368
BLOCK 17											1.476
DMH/FH	13.191	6.159	6.521	7.875	9.835	8.882	13.585	10.730	10.202	10.666	12.464

T/M H-53E MAINTENANCE DATA — DIRECT MAINT MANHOURS / VERIFIED FAILURE

BY FISCAL YEAR

PRODUCTION	81	82	83	84	85	86	87	88	89	90	91
BLOCK 01	5.562	5.004	4.597	4.799	5.509	5.295	4.843	5.307	4.586	5.193	4.729
BLOCK 02	7.457	5.588	4.276	4.457	5.436	4.961	5.014	5.427	4.945	5.255	5.396
BLOCK 03		5.379	4.513	4.888	5.743	4.894	5.159	4.416	5.286	4.942	6.432
BLOCK 04			3.929	4.319	4.365	5.104	7.322	6.689	5.350	5.123	5.088
BLOCK 05				5.328	4.908	5.117	5.230	5.228	5.093	5.450	5.839
BLOCK 06				4.597	5.165	4.575	5.516	5.235	4.863	5.597	5.937
BLOCK 07					4.055	4.421	4.201	4.107	4.809	5.734	6.958
BLOCK 08					3.305	4.660	4.389	4.051	5.210	5.335	5.268
BLOCK 09						4.822	3.276	3.828	4.508	4.965	4.161
BLOCK 10							3.753	3.557	4.267	3.580	3.943
BLOCK 11								3.089	3.880	2.594	3.786
BLOCK 12								2.688	4.066	4.542	4.411
BLOCK 13									3.449	2.872	2.724
BLOCK 14									3.876	4.532	4.194
BLOCK 15										3.243	3.796
BLOCK 16										5.123	5.935
BLOCK 17											4.220
DMH/VF	6.061	5.418	4.383	4.618	4.943	4.932	5.499	4.990	4.820	4.510	4.586

H-53E AGE DATA FISCAL TO SERVICE YEAR CHART

SERVICE YEAR

BLK	0 DELV	1	2	3	4	5	6	7	8	9	10
01	81	82	83	84	85	86	87	88	89	90	91
02	81	82	83	84	85	86	87	88	89	90	91
03	82	83	84	85	86	87	88	89	90	91	
04	83	84	85	86	87	88	89	90	91		
05	83	84	85	86	87	88	89	90	91		
06	84	85	86	87	88	89	90	91			
07	85	86	87	88	89	90	91				
08	85	86	87	88	89	90	91				
09	86	87	88	89	90	91					
10	87	88	89	90	91						
11	88	89	90	91							
12	88	89	90	91							
13	89	90	91								
14	89	90	91								
15	90	91									
16	90	91									
17	91										

DATA EXTRACTED FROM NALDA ECA REPORTS

AIRCRAFT USAGE INFORMATION:

H-53E REPORTED TOTAL FLIGHT HOURS BY PROCUREMENT BLOCK

SERVICE YEAR	0	1	2	3	4	5	6	7	8	9	10
PROD BLOCK											
BLOCK 01	99.5	959.5	1390.7	1011.5	920.5	960.4	340.2	734.9	1377.4	881.1	820.6
BLOCK 02	62.7	2765.3	4316.5	3164.2	2893.6	2887.3	1457.1	2376.5	2708.0	2176.7	2192.6
BLOCK 03	839.3	4008.3	3539.3	2480.5	2577.2	1385.6	2460.2	4301.2	3378.3	2702.1	
BLOCK 04	990.5	5450.9	5441.4	4561.5	3341.6	4487.3	4138.2	4511.4	77.0		
BLOCK 05		2059.4	3042.5	2412.6	1453.2	2245.7	1986.8	2232.6	2695.6		
BLOCK 06	702.8	3114.0	2910.8	1749.5	1415.7	1737.7	1934.4	1961.2			
BLOCK 07	1283.7	3444.0	2168.3	3236.7	3190.8	3055.8	2019.8				
BLOCK 08	63.3	2861.2	1748.6	2836.3	2359.2	2492.5	1881.5				
BLOCK 09	82.5	542.4	1167.0	1524.8	970.7	1223.6					
BLOCK 10	853.3	3266.5	2624.6	4063.8	2959.8						
BLOCK 11	934.1	1523.1	1074.5	516.0							
BLOCK 12	105.4	2542.4	2370.3	3049.0							
BLOCK 13	851.2	2908.8	3517.1								
BLOCK 14	557.4	1463.1	1453.4								
BLOCK 15	411.5	2267.3									
BLOCK 16	700.7	2219.8									
BLOCK 17	448.8										
TOTAL FLT HRS:	8986.7	41396.0	36765.0	30606.4	22082.3	20475.9	16218.2	16117.8	13836.3	5759.9	3013.2

T/M: H-53E AVERAGE NUMBER OF REPORTING AIRCRAFT BY PROCUREMENT BLOCK

SERVICE YEAR	0	1	2	3	4	5	6	7	8	9	10
PROD BLOCK											
BLOCK 01	2.1	3.9	3.9	3.6	3.0	4.2	1.9	2.3	3.8	3.7	4.5
BLOCK 02	1.3	10.2	12.8	9.6	9.2	9.5	5.3	6.7	8.5	9.1	9.1
BLOCK 03	6.3	13.5	12.6	10.6	9.7	5.9	9.3	13.5	13.1	11.8	
BLOCK 04	4.3	11.5	11.1	10.6	8.2	8.1	9.8	10.5	8.5		
BLOCK 05		7.0	9.3	9.8	4.9	7.0	8.4	9.1	9.1		
BLOCK 06	3.4	8.8	9.1	6.0	4.8	6.2	8.0	7.6			
BLOCK 07	6.3	10.4	7.0	8.7	8.6	10.2	8.4				
BLOCK 08	0.9	5.7	5.8	7.4	6.1	8.0	7.1				
BLOCK 09	0.7	1.3	3.0	3.2	2.9	4.2					
BLOCK 10	2.8	7.9	7.3	8.5	7.2						
BLOCK 11	2.8	3.7	3.0	2.1							
BLOCK 12	0.1	8.2	10.0	9.2							
BLOCK 13	2.0	7.4	7.9								
BLOCK 14	1.8	5.1	4.4								
BLOCK 15	1.9	6.2									
BLOCK 16	1.8	6.6									
BLOCK 17	1.3										
AVG REPORT AC:	39.8	117.4	107.2	88.3	64.6	63.3	58.2	49.7	43.0	24.6	13.6

WORKSHEET FOR EVALUATION OF H-53E MAINTENANCE DATA
H-53E CALCULATED MAINTENANCE PARAMETERS

MEAN FLIGHT HOURS BETWEEN VERIFIED FAILURES (MFHBF) ALL WUCS REPORTING

SERVICE YEAR	0	1	2	3	4	5	6	7	8	9	10
PROD BLOCK											
BLOCK 01	0.38	0.82	0.69	0.46	0.38	0.35	0.31	0.33	0.4	0.35	0.32
BLOCK 02	0.67	0.94	0.63	0.53	0.49	0.45	0.28	0.36	0.4	0.34	0.34
BLOCK 03	0.72	0.67	0.57	0.44	0.50	0.41	0.45	0.67	0.58	0.44	
BLOCK 04	0.95	0.59	0.39	0.38	0.33	0.35	0.29	0.33	0.29		
BLOCK 05		0.89	0.63	0.82	0.36	0.45	0.33	0.63	0.46		
BLOCK 06	1.24	0.79	0.68	0.52	0.55	0.63	0.62	0.54			
BLOCK 07	0.80	0.80	0.60	0.73	0.70	0.72	0.54				
BLOCK 08	1.15	1.31	0.56	0.73	0.63	0.57	0.45				
BLOCK 09	2.29	0.72	0.70	0.49	0.32	0.30					
BLOCK 10	0.57	0.42	0.30	0.29	0.21						
BLOCK 11	0.50	0.44	0.24	0.18							
BLOCK 12	2.64	1.12	0.65	0.58							
BLOCK 13	0.57	0.35	0.24								
BLOCK 14	1.80	0.87	0.56								
BLOCK 15	0.46	0.30									
BLOCK 16	3.10	1.29									
BLOCK 17	2.86										
AVG MFHBF:	0.80	0.66	0.45	0.46	0.40	0.45	0.37	0.43	0.40	0.38	0.34

REPORTED DIRECT MAINTENANCE MANHOURS PER FLIGHT HOUR (DMH/FH) ALL WUCS REPORTING

SERVICE YEAR	0	1	2	3	4	5	6	7	8	9	10
PROD BLOCK											
BLOCK 01	14.53	5.63	6.66	10.42	14.42	15.06	23.16	15.97	11.13	14.76	14.88
BLOCK 02	11.06	5.93	6.79	8.35	11.18	10.98	19.46	15.04	11.41	15.66	15.70
BLOCK 03	7.51	6.77	8.57	13.01	9.78	12.70	9.92	7.89	8.94	14.65	
BLOCK 04	4.15	7.33	11.12	13.34	22.16	19.25	18.60	15.59	17.53		
BLOCK 05		6.02	7.84	9.93	14.44	11.53	15.32	12.58	12,79		
BLOCK 06	3.71	6.53	6.78	10.67	9.58	7.41	9.09	10.96			
BLOCK 07	5.04	4.58	6.99	5.61	6.20	7.98	12.86				
BLOCK 08	2.87	3.57	7.77	5.56	8.22	9.30	11.74				
BLOCK 09	2.10	4.56	5.47	9.24	15.43	13.68					
BLOCK 10	6.59	8.37	14.38	12.24	18.83						
BLOCK 11	6.18	8.91	10.83	21.00							
BLOCK 12	1.02	3.64	6.96	7.64							
BLOCK 13	6.04	8.22	11.58								
BLOCK 14	2.07	5.22	7.27								
BLOCK 15	7.06	8.32									
BLOCK 16	1.65	5.37									
BLOCK 17	1.48										
AVG DMH/FH:	4.95	6.34	8.84	9.95	13.09	12.37	14.41	12.49	12.68	15.05	15.47

REPORTED DIRECT MAINTENANCE MANHOURS PER VERIFIED FAILURE (DMH/VF) ALL WUCS REPORTING

SERVICE YEAR	0	1	2	3	4	5	6	7	8	9	10
PROD BLOCK											
BLOCK 01	5.56	5.00	4.60	4.80	5.51	5.30	4.84	5.31	4.59	5.19	4.73
BLOCK 02	7.46	5.59	4.28	4.46	5.64	4.96	5.01	5.43	4.94	5.25	5.40
BLOCK 03	5.38	4.51	4.89	5.74	4.89	5.16	4.42	5.29	4.94	6.43	
BLOCK 04	3.93	4.33	4.37	5.18	7.32	6.69	5.35	5.12	5.09		
BLOCK 05		5.33	4.91	5.12	5.23	5.23	5.09	5.45	5.84		
BLOCK 06	4.60	5.17	4.58	5.82	5.23	4.66	5.60	5.94			
BLOCK 07	4.06	4.42	4.28	4.11	4.81	5.73	6.96				
BLOCK 08	3.31	4.66	4.39	4.05	5.31	5.34	5.27				
BLOCK 09	4.82	3.28	3.83	4.51	4.96	4.16					
BLOCK 10	3.75	3.56	4.27	3.58	3.94						
BLOCK 11	3.09	3.60	2.59	3.79							
BLOCK 12	2.69	4.07	4.54	4.41							
BLOCK 13	3.45	2.87	2.72								
BLOCK 14	3.88	4.53	4.09								
BLOCK 15	3.24	3.20									
BLOCK 16	3.12	6.94									
BLOCK 17	4.22										
AVG DMH/VF:	3.94	4.16	4.02	4.53	5.24	5.53	5.28	5.34	5.12	5.72	5.20

H-53E SIGNIFICANT MAJOR SYSTEMS CONTRIBUTING TO MAINTENANCE WORKLOAD
BASED ON TOTAL REPORTED WUC FAILURE AND DIRECT MAINTENANCE MANHOUR DATA

WUC		RANK	FAILURES	MANHOURS	% CHANGE PER YEAR (- indicates decrease) MFHFB	DMH/FH	DMH/VF
11	AIRFRAME	1	88085	304441.4	-0.043	0.192	0.054
15	ROTOR	2	72297	475759.4	-0.023	0.073	0.044
29	ENG INSTAL	3	59271	264790.6	-0.054	0.248	0.059
26	DRIVES/XMSN	4	29629	162247.9	-0.041	0.086	0.021
42	ELECT PWR	5	26501	114845.9	-0.068	0.161	0.010
13	LDGEAR	6	22075	88711.6	-0.035	0.080	0.014
12	FUSLG COMPT	7	20207	63276.1	-0.047	0.166	0.040
46	FUEL SYS	8	19753	85326.1	-0.053	0.169	0.033
22	ENGINES	9	18910	75014.4	0.115	-0.012	0.051
14	FLT CONTR	10	17246	133485.7	-0.051	0.083	0.010
44	LIGHTING	11	17019	52753.6	-0.034	0.047	0.000
24	AUX PWR	12	12234	54555.9	-0.013	0.028	0.016
45	HYD/PNEU	13	10692	58777.7	-0.031	0.036	-0.001
49	MSC UTIL	14	8047	30638.0	0.135	-0.050	0.017
57	INTGR GUID	15	7115	50650.9	-0.052	0.179	0.030
64	INTERCOM	16	6633	35982.5	-0.024	0.221	0.130
51	INSTR	17	5133	25044.8	-0.051	0.651	0.128
71	RADIO NAV	18	4676	32041.4	-0.060	0.216	0.050
62	VHF	19	2924	22448.5	-0.025	0.256	0.144
63	UHF	20	2256	10925.9	-0.053	0.317	0.093
72	RADAR NAV	21	2216	16647.1	-0.008	0.019	0.010
56	FLT REF	22	2189	19487.2	-0.037	0.052	-0.000
61	HF	23	2029	12332.8	-0.015	0.055	0.048
76	COUNTERMEAS	24	1247	4436.8	-0.074	1.724	0.033
91	EMERG EQUIP	25	961	1795.7	0.270	-0.044	0.077
65	IFF	26	951	8401.9	-0.047	0.119	0.022
41	AC/PRES	27	895	5428.4	-0.025	0.053	0.020
67	COM/NAV/IFF	28	547	2090.0	-0.091	0.402	-0.031
97	EXPL DEV	29	401	846.4	-0.100	13.788	0.095
75	WEAPN DEL	30	331	827.5	-0.070	6.257	0.024
66	ELT	31	211	3298.3	-0.104	1.291	0.014
96	PERS EQUIP	32	68	463.7	-0.070	-0.035	-0.048
73	BOMBING NAV	33	68	303.6	0.011	0.055	0.104
69	MSC COMM	34	35	73.5	-0.104	0.146	-0.087
92	TOW TARGET	35	27	97.9	-0.084	-0.052	-0.060
77	PHOTORECON	36	7	9.1	-0.057	-0.016	0.029
	TOTAL		463757	2222257.5			

H-53E HELICOPTER TOTAL AIRCRAFT, ALL WUC SYSTEMS

TREND LINE BASED ON MEAN FLIGHT HOURS BETWEEN FAILURE ALL BLOCKS

SVC YR	MFHBF	PREDICT
0	0.80	0.56
1	0.66	0.53
2	0.45	0.51
3	0.48	0.48
4	0.40	0.47
5	0.45	0.44
6	0.37	0.42
7	0.43	0.40
8	0.40	0.38
9	0.38	0.36
10	0.34	0.33

Regression Output:		
Constant		0.555
Std Err of Y Est		0.060
R Squared		0.583
No. of Observations		10.000
Degrees of Freedom		8.000
X Coefficient(s)	-0.022	
Std Err of Coef.	0.007	
CHANGE FACTOR:		0.912
% CHANGE OVER 10 YRS:		-0.400
% CHANGE/YR:		-0.040
SLOPE (- DECREASE):		-0.022

TREND LINE BASED ON MAINTENANCE HOURS PER FLIGHT HOUR ALL BLOCKS

SVC YR	DMH/FH	PREDICT
0	4.98	7.42
1	6.34	8.26
2	8.84	9.11
3	9.96	9.96
4	13.09	10.80
5	12.37	11.64
6	14.41	12.49
7	12.49	13.34
8	12.68	14.18
9	15.06	15.03
10	15.47	15.87

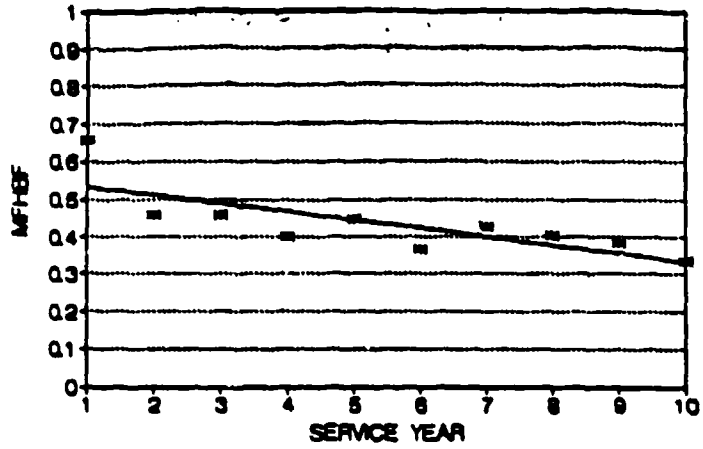
Regression Output:		
Constant		7.416
Std Err of Y Est		1.432
R Squared		0.783
No. of Observations		10.000
Degrees of Freedom		8.000
X Coefficient(s)	0.846	
Std Err of Coef.	0.158	
CHANGE FACTOR:		1.013
% CHANGE OVER 10 YRS:		1.140
% CHANGE/YR:		0.114
SLOPE (- DECREASE):		0.846

TREND LINE BASED ON MAINTENANCE HOURS PER VERIFIED FAILURE ALL BLOCKS

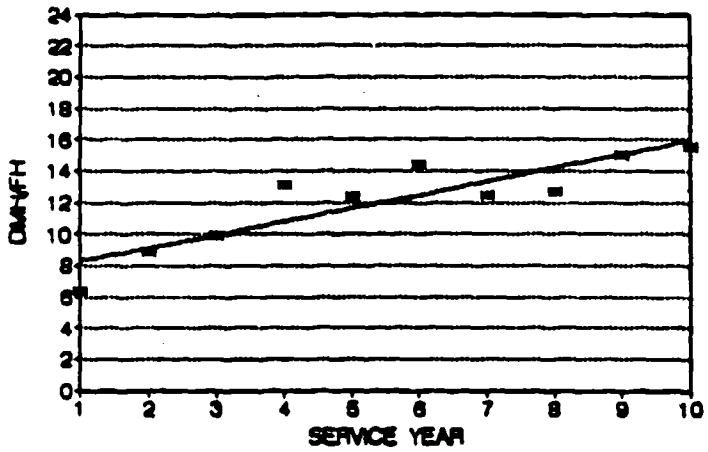
SVC YR	DMH/VF	PREDICT
0	3.94	4.20
1	4.16	4.35
2	4.02	4.50
3	4.53	4.65
4	5.24	4.79
5	5.53	4.94
6	5.28	5.09
7	5.34	5.24
8	5.12	5.38
9	5.72	5.53
10	5.20	5.68

Regression Output:		
Constant		4.203
Std Err of Y Est		0.369
R Squared		0.597
No. of Observations		10.000
Degrees of Freedom		8.000
X Coefficient(s)	0.147	
Std Err of Coef.	0.043	
CHANGE FACTOR:		0.901
% CHANGE OVER 10 YRS:		0.351
% CHANGE/YR:		0.035
SLOPE (- DECREASE):		0.147

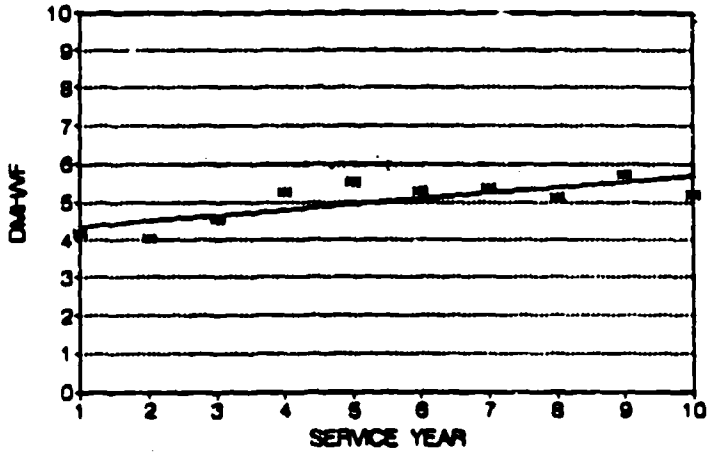
H-53E MEAN FLIGHT HOUR PER FAILURE TREND
ALL BLOCKS, TOTAL AIRCRAFT, ALL WUC SYSTEMS



H-53E MAINTENANCE HOURS PER FLIGHT HOUR TREND
ALL BLOCKS, TOTAL AIRCRAFT, ALL WUC SYSTEMS

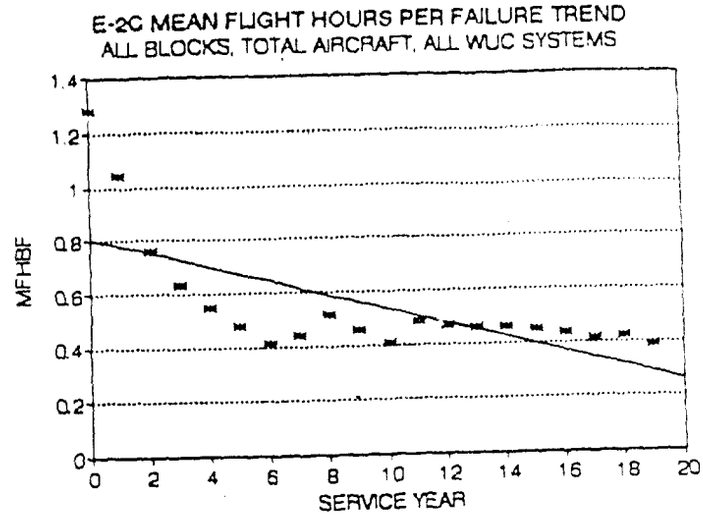


H-53E MAINTENANCE HOURS PER FAILURE TREND
ALL BLOCKS, TOTAL AIRCRAFT, ALL WUC SYSTEMS



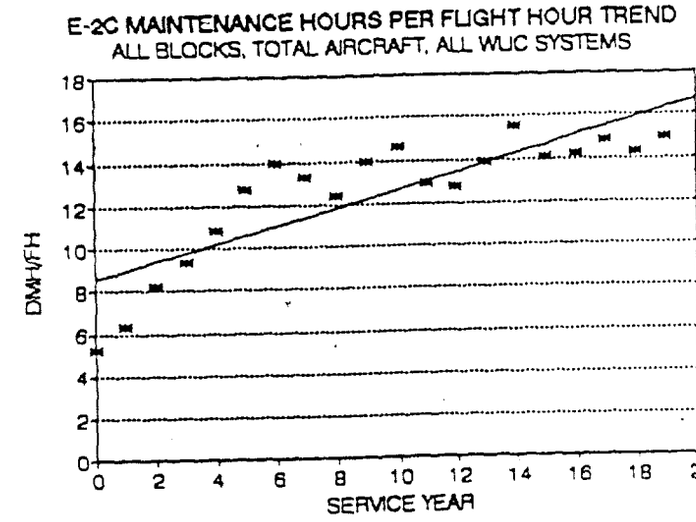
E-2C
TREND LINE BASED ON MEAN FLIGHT HOURS BETWEEN FAILURE

SVC Y	MFHBF	PREDICT	Regression Output:		
0	1.28	0.81			
1	1.04	0.78	Constant		0.808934
2	0.78	0.75	Std Err of Y Est		0.166841
3	0.83	0.73	R Squared		0.490361
4	0.55	0.70	No. of Observations		20
5	0.48	0.67	Degrees of Freedom		18
6	0.41	0.64			
7	0.44	0.62	X Coefficient(s)	-0.02728	
8	0.51	0.59	Std Err of Coef.	0.006551	
9	0.46	0.56			
10	0.41	0.53	CHANGE FACTOR:		0.897
11	0.49	0.51	% CHANGE OVER 10 YRS:		-0.338
12	0.47	0.48	% CHANGE/YR:		-0.034
13	0.46	0.45	SLOPE (- DECREASE):		0.027
14	0.46	0.43			
15	0.45	0.40			
16	0.44	0.37			
17	0.41	0.34			
18	0.42	0.32			
19	0.39	0.29			
20		0.26			



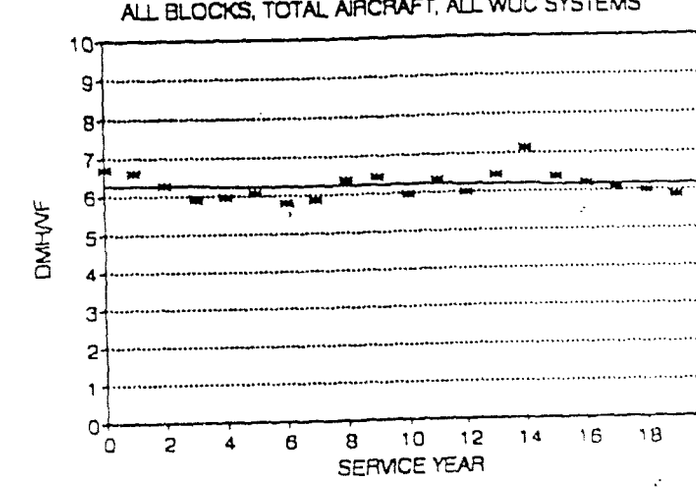
E-2C
TREND LINE BASED ON MAINTENANCE HOURS PER FLIGHT HOUR

SVC Y	DMH/FH	PREDICT	Regression Output:		
0	5.21	8.56			
1	6.32	8.98	Constant		8.554631
2	8.21	9.37	Std Err of Y Est		1.713017
3	9.35	9.78	R Squared		0.676672
4	10.86	10.18	No. of Observations		20
5	12.76	10.58	Degrees of Freedom		18
6	14.00	11.00			
7	13.30	11.41	X Coefficient(s)	0.407713	
8	12.42	11.82	Std Err of Coef.	0.088428	
9	14.00	12.22			
10	14.61	12.63	CHANGE FACTOR:		0.929
11	12.95	13.04	% CHANGE OVER 10 YRS:		0.477
12	12.78	13.45	% CHANGE/YR:		0.048
13	13.92	13.86	SLOPE (- DECREASE):		-0.408
14	15.53	14.26			
15	14.09	14.67			
16	14.21	15.08			
17	14.80	15.49			
18	14.30	15.89			
19	14.96	16.30			
20		16.71			

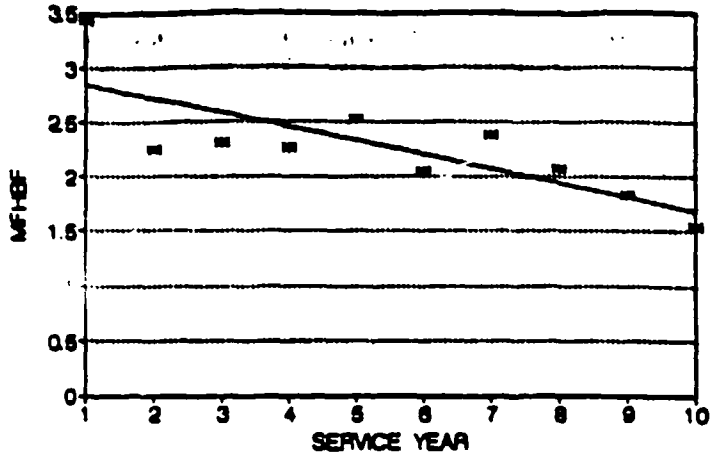


E-2C
TREND LINE BASED ON MAINTENANCE HOURS PER VERIFIED FAILURE

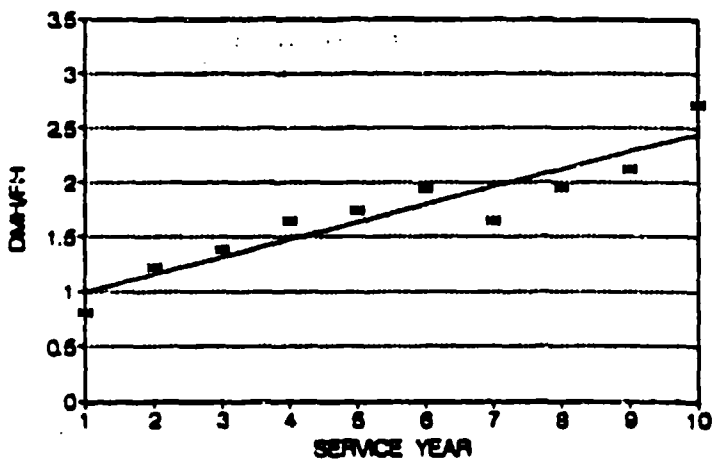
SVC Y	DMH/VF	PREDICT	Regression Output:		
0	6.68	6.26			
1	6.58	6.25	Constant		6.258649
2	6.25	6.25	Std Err of Y Est		0.342838
3	5.89	6.24	R Squared		0.00913
4	5.96	6.24	No. of Observations		20
5	6.07	6.23	Degrees of Freedom		18
6	5.80	6.23			
7	5.87	6.22	X Coefficient(s)	-0.00541	
8	6.38	6.22	Std Err of Coef.	0.013295	
9	6.42	6.21			
10	5.97	6.20	CHANGE FACTOR:		0.822
11	6.32	6.20	% CHANGE OVER 10 YRS:		-0.009
12	6.00	6.19	% CHANGE/YR:		-0.001
13	6.40	6.19	SLOPE (- DECREASE):		0.005
14	7.13	6.18			
15	6.38	6.18			
16	6.18	6.17			
17	6.07	6.17			
18	5.93	6.16			
19	5.83	6.16			
20		6.15			



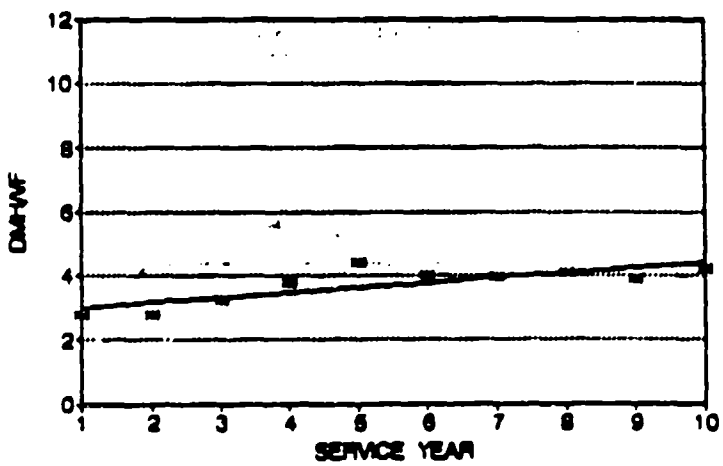
H-53E MEAN FLIGHT HOUR PER FAILURE TREND
ALL AIRCRAFT, WUC 11, AIRFRAME



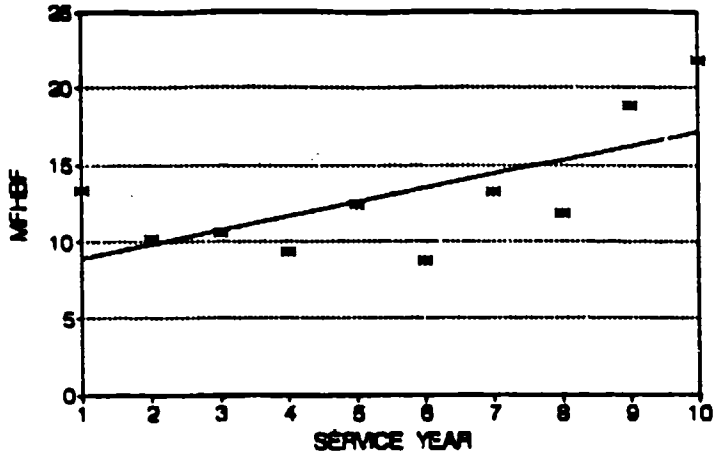
H-53E MAINTENANCE HOURS PER FLIGHT HOUR TREND
ALL AIRCRAFT, WUC 11, AIRFRAME



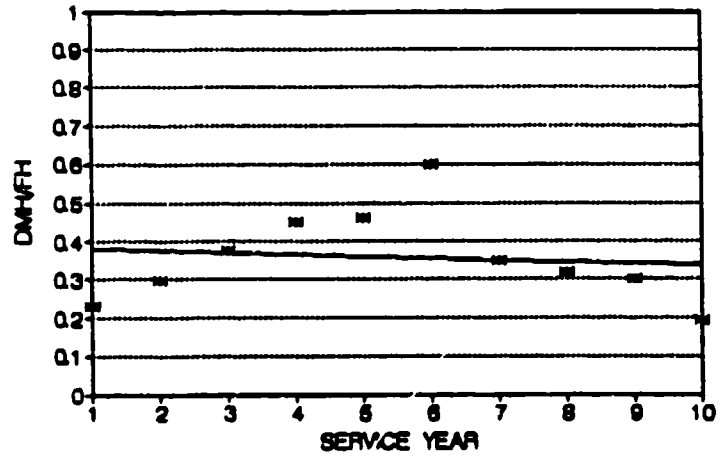
H-53E MAINTENANCE HOURS PER FAILURE TREND
ALL AIRCRAFT, WUC 11, AIRFRAME



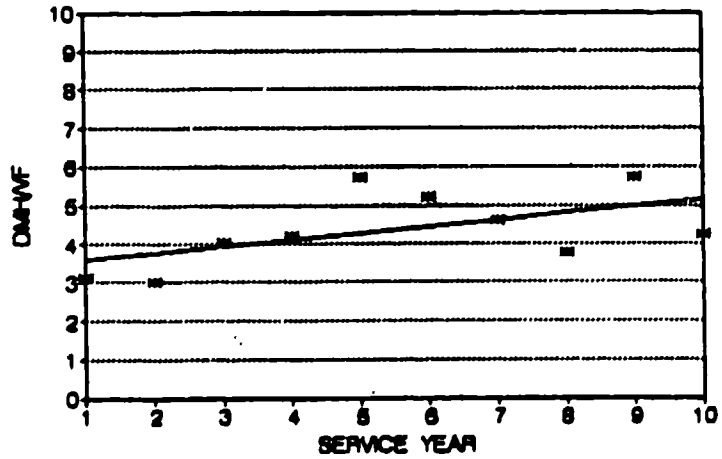
H-53E MEAN FLIGHT HOUR PER FAILURE TREND
ALL AIRCRAFT, WUC 22, ENGINES



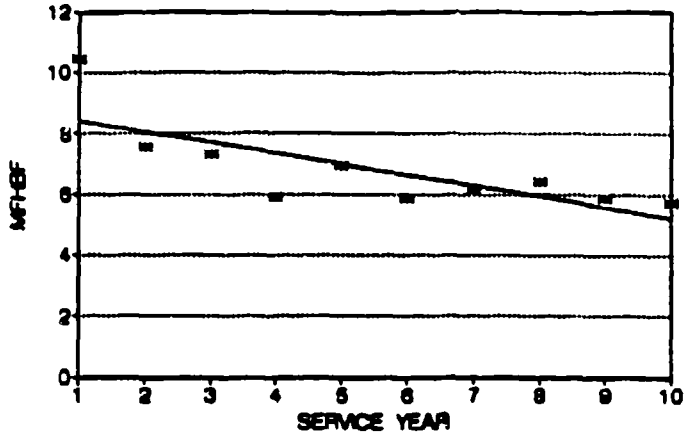
H-53E MAINTENANCE HOURS PER FLIGHT HOUR TREND
ALL AIRCRAFT, WUC 22, ENGINES



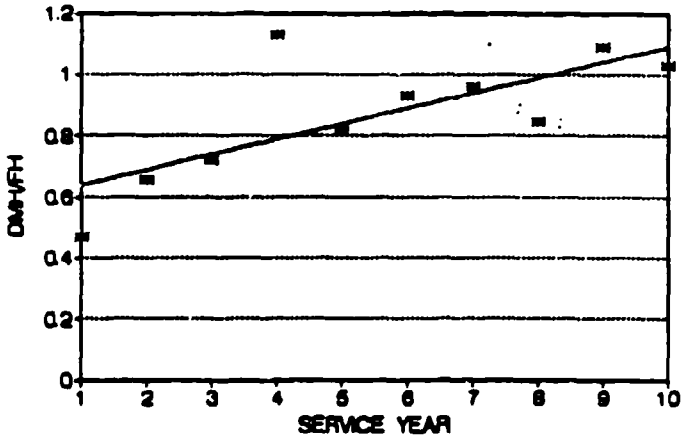
H-53E MAINTENANCE HOURS PER FAILURE TREND
ALL AIRCRAFT, WUC 22, ENGINES



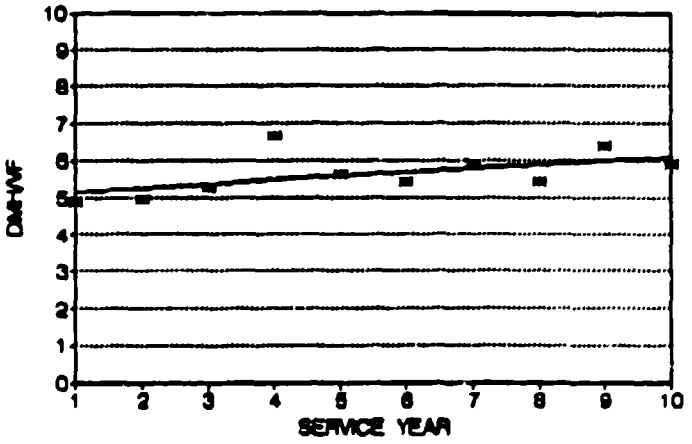
H-53E MEAN FLIGHT HOUR PER FAILURE TREND
ALL AIRCRAFT, WUC 28, DRIVES/XMSN



H-53E MAINTENANCE HOURS PER FLIGHT HOUR TREND
ALL AIRCRAFT, WUC 28, DRIVES/XMSN

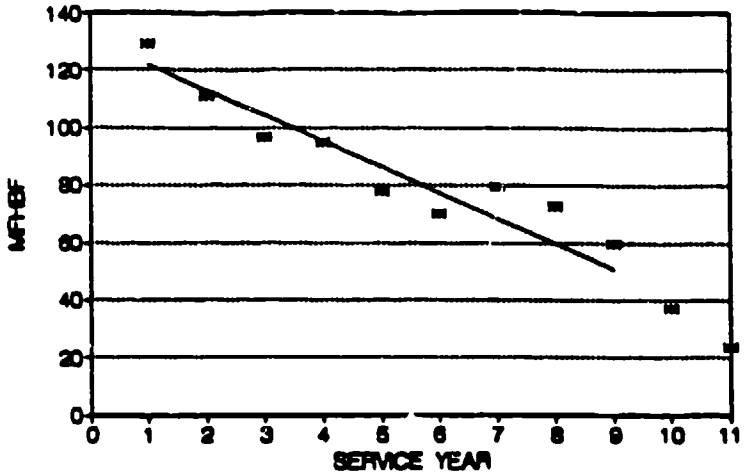


H-53E MAINTENANCE HOURS PER FAILURE TREND
ALL AIRCRAFT, WUC 28, DRIVES/XMSN

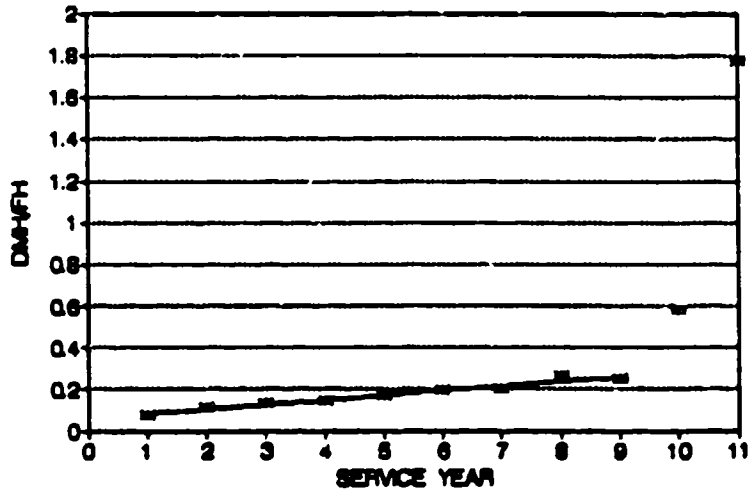


COMPARISON CHARTS SHOWING AGE RELATED TRENDS
WORK UNIT CODE 57 (INGEGRATED GUIDANCE)

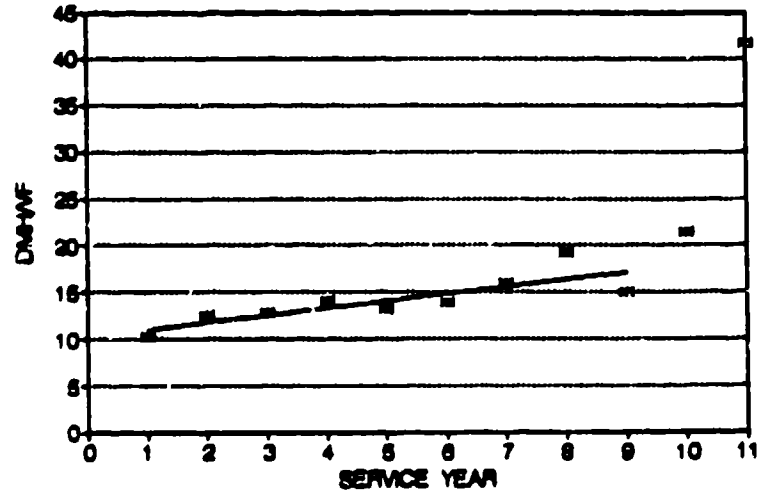
F/A-18A/B MEAN FLIGHT HOUR PER FAILURE TREND
WUC 57 (INTEGRATED GUIDANCE)



F/A-18A/B MAINTENANCE HOURS PER FLIGHT HOUR TREND
WUC 57 (INTEGRATED GUIDANCE)

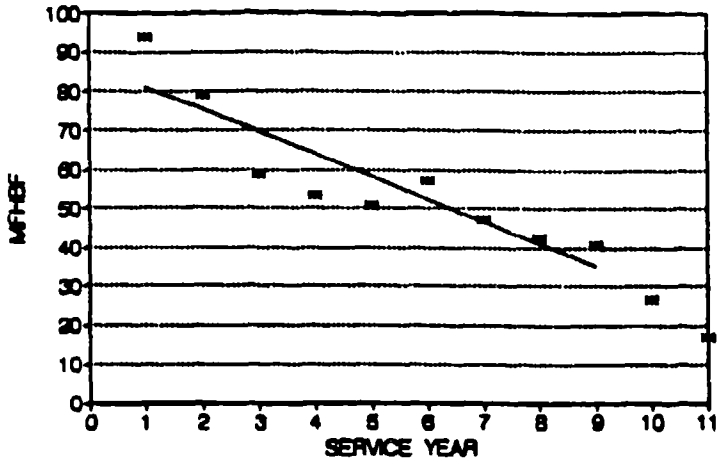


F/A-18A/B MAINTENANCE HOURS PER FAILURE TREND
WUC 57 (INTEGRATED GUIDANCE)

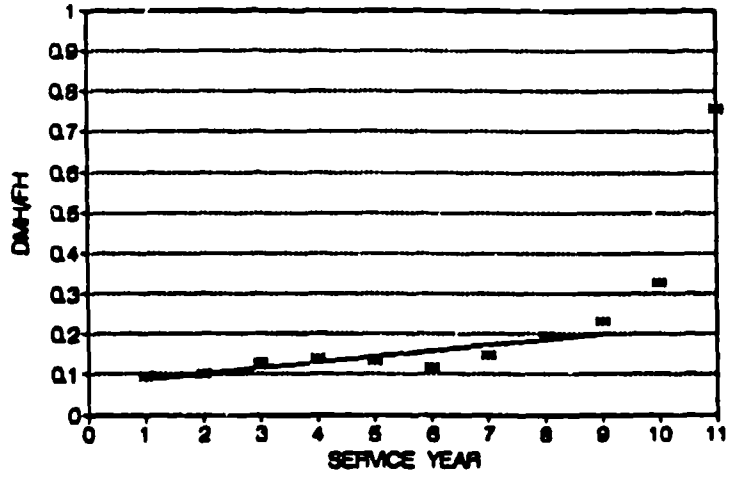


COMPARISON CHARTS SHOWING AGE RELATED TRENDS
WORK UNIT CODE 29 (POWER PLANT INSTALL)

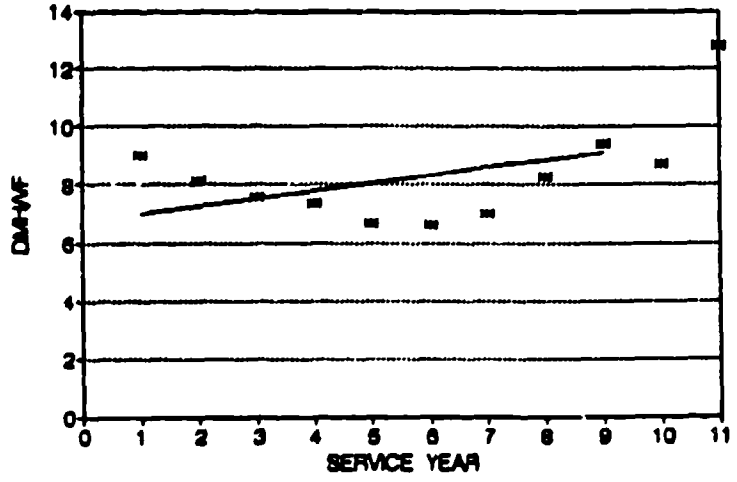
F/A-18A/B MEAN FLIGHT HOUR PER FAILURE TREND
WUC 29 (PWR PLNT INSTALL)



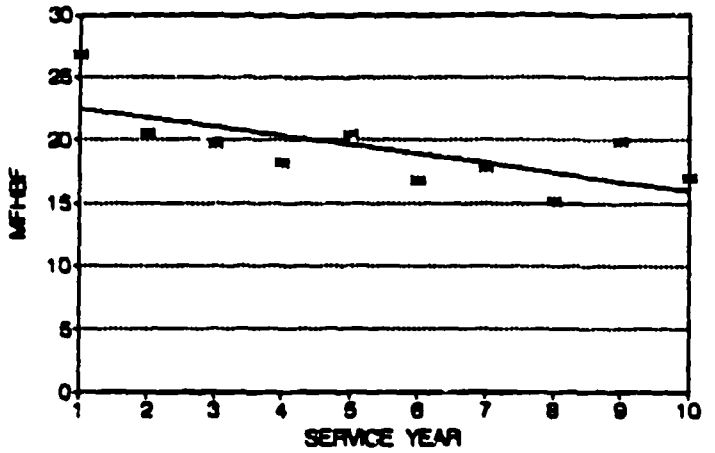
F/A-18A/B MAINTENANCE HOURS PER FLIGHT HOUR TREND
WUC 29 (PWR PLNT INSTALL)



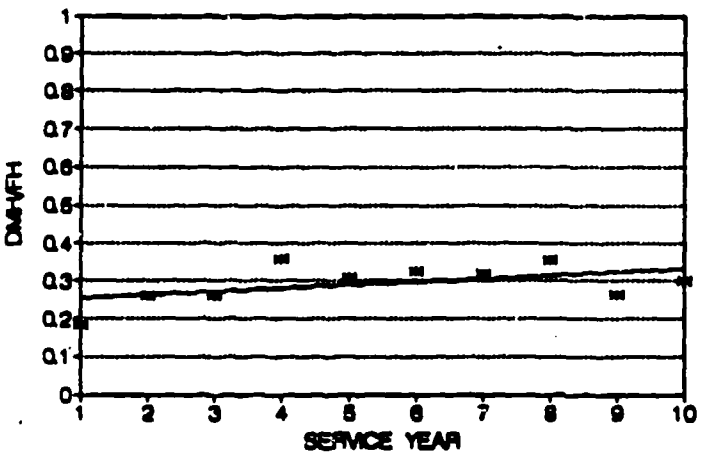
F/A-18A/B MAINTENANCE HOURS PER FAILURE TREND
WUC 29 (PWR PLNT INSTALL)



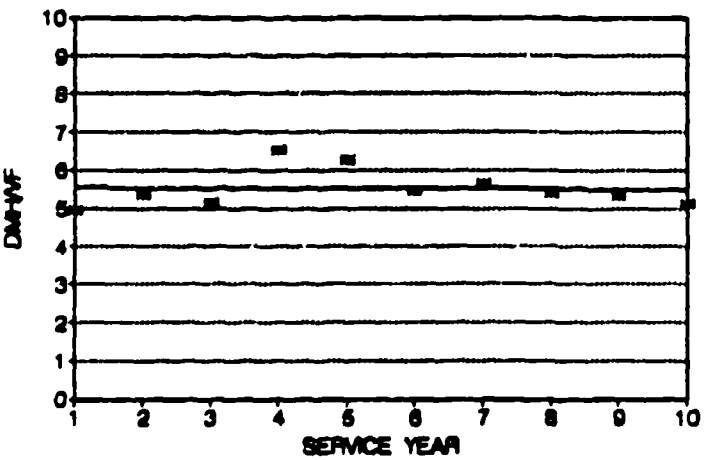
H-53E MEAN FLIGHT HOUR PER FAILURE TREND
ALL AIRCRAFT, WUC 45, HYD/PNEU



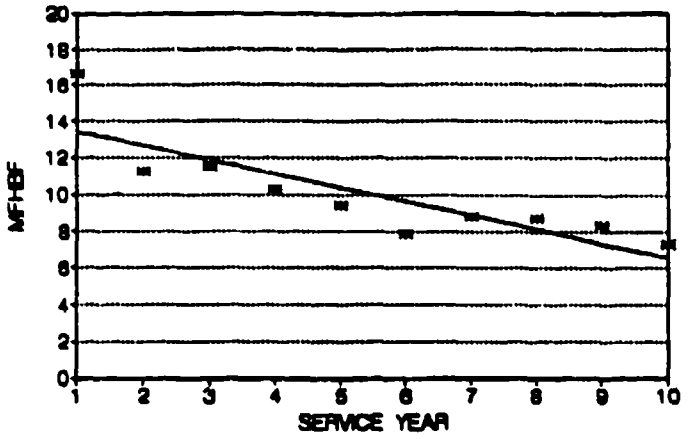
H-53E MAINTENANCE HOURS PER FLIGHT HOUR TREND
ALL AIRCRAFT, WUC 45, HYD/PNEU



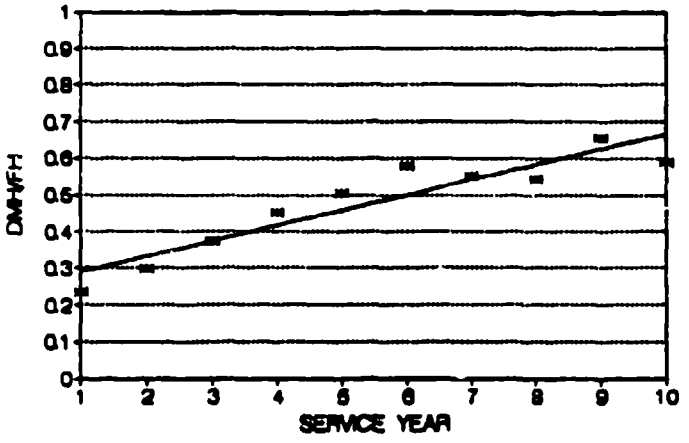
H-53E MAINTENANCE HOURS PER FAILURE TREND
ALL AIRCRAFT, WUC 45, HYD/PNEU



H-53E MEAN FLIGHT HOUR PER FAILURE TREND
ALL AIRCRAFT, WUC 46, FUEL SYSTEM



H-53E MAINTENANCE HOURS PER FLIGHT HOUR TREND
ALL AIRCRAFT, WUC 46, FUEL SYSTEM



H-53E MAINTENANCE HOURS PER FAILURE TREND
ALL AIRCRAFT, WUC 46, FUEL SYSTEM